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Final Report — Phase I

June 20, 1974

DEVELOPMENT OF METHODOLOGIES AND PROCEDURES FOR IDENTIFYING STS USERS AND USES

By: J.L. Archer, N.A. Beauchamp, D.C. MacMichael

Prepared for:
George C. Marshall Space Flight Center
Marshall Space Flight Center
Alabama 38512

SRI Project EGU3303

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CONTENTS

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CONTENTS (Continued)

CONTENTS (Continued)

ILLUSTRATIONS

TABLES

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ABBREVIATIONS

AEC	Atomic Energy Commission
BNDD	Bureau of Narcotics and Dangerous Drugs
BRAVO	Business Risk and Value Operations in Space
BUS	Beneficial Uses of Space
CVT	Concept Verification Testing
DBMS	Data Base Management System
DoD	Department of Defense
EPA	Environmental Protection Agency
ERTS	Earth Resources Technology Satellite
FARM	Field Anomaly Relaxation Method
FEO	Federal Energy Office
frsl	futures-responsive-societal-learning
G.E.	General Electric
GNP	Gross National Product
HEW	Health, Education, and Welfare
LDC	Lesser Developed Country
lrsp	long-range-societal-planning
NASA	National Aeronautics and Space Administration
R&D	Research and Development
SRI	Stanford Research Institute
STS	Space Transportation System
VA	Veterans Administration

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I INTRODUCTION

A. GENERAL

The use of manned space flight, advances in space sciences, and applications of NASA-developed technology have already proved their benefits to mankind in many areas as explicitly pointed out in the 1971 symposium, "Space for Mankind's Benefits,"[1*] held in Huntsville, Alabama. Some of the more obvious benefits thus far have resulted from the use of the Nimbus satellite for climatology data and weather forecasting, the Earth Resources Technology Satellite (ERTS) for discovering new earth resources, the Early Bird satellite for improved communications, and Skylab for multi-disciplinary investigations of space science applications.

With this as prologue, the space age is now in the process of attaining significant levels of both technological and economic maturity with the coming of the new Space Transportation System (STS), which will become operational in the 1980's. The most distinguishing characteristics of this new STS are the reusable Space Shuttle booster, the Orbiter, and the Space Tug. The future availability of the Shuttle and its associated space systems makes possible an enormous spectrum of potential uses with benefits for all mankind. The lower program costs, increased versatility, and flexibility of the STS can economically provide services and products never before available to the world at a time when they are needed most. This means that new demands can be met for commercial uses, environmental uses, national security, scientific uses, international cooperation, and many other governmental uses. Specifically, efficient use of the STS can provide major contributions, both directly and in support of existing and future government programs, for solving the following problems: the energy crisis, the climate crisis, the food and water crises, and economic insecurity.

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* Superscript numbers indicate references listed at the end of this report.

NASA has recognized, however, that the mere existence of the STS capability is not sufficient to assure its efficient and appropriate use by other organizations to solve problems of national and international significance. Such use can be assured only by the explicit identification of the user community and its needs along with the benefits and advantages of the STS in meeting these needs. Similar conclusions have been reached concerning the use of other NASA capabilities.

B. BACKGROUND

In response to this recognized need to identify new users and uses of the STS and other NASA capabilities, NASA has funded several studies to develop techniques to identify beneficial uses of space. Among the first of these studies were General Electric's (G.E.'s) Beneficial Uses of Space (BUS)[2] studies and the Aerospace Corporation's Business Risk and Value Operations in Space (BRAVO)[3] studies.

General Electric's BUS studies used only a direct interface, or dialogue, methodology to identify new uses. The BUS methodology employed no organized set of techniques, but rather used individual contacts, each tailored to an individual potential user.

Aerospace Corporation's BRAVO studies used a methodology "involving the optimization of satellite designs in terms of reliability and cost, identification and selection of practical satellite system maintenance strategies, and comparisons of space and ground systems in clear and meaningful terms."[3]

Both of these studies provided meaningful information on beneficial uses of space. However, it was clear they did not furnish a systematic method for identifying new users and uses over the lifetime of the STS. Therefore, NASA developed a plan, consisting of three phases, to assure the expedient utilization and application of the STS capabilities through mission and payload planning for the 1980's and 1990's. The three phases are: (1) the development of methodologies for identifying STS uses and users, (2) the implementation of the methodologies, and (3) the operation of the methodologies to yield new users and uses for the STS. NASA has

initiated the Phase I studies of this effort and SRI is one of the contractors supporting NASA in this endeavor.

C. SCOPE OF SRI STUDY

This report documents the results of a six-month Phase I study, performed for NASA by Stanford Research Institute (SRI) to develop methodologies for identifying new uses and users of the STS in the domestic government sector.* This work was performed for the George C. Marshall Space Flight Center under Contract No. NAS8-30533.

The methodology developed in this study was designed to identify new uses and users of the new Space Transportation System (STS) within the domestic government sector, excluding NASA and the Department of Defense (DoD). In contrast to other studies, this methodology consists of a series of analytical techniques and well-defined functions (including direct interfaces between NASA and users) structured as an integrated planning process to assure efficient and meaningful use of the STS. The derived methodology has proven to be of direct utility to other NASA capabilities by being adaptable to organized planning activities for both current and future programs. The considerations which are included in the BUS and BRAVO studies described above are included in, but form only a portion of, the methodology documented in this report.

The methodology defined in this study is an organized process that will permit NASA to: (1) realize efficient and economic use of the STS and other NASA capabilities, (2) identify new users and uses of the STS, (3) contribute to organized planning activities for both current and future programs, and (4) aid in analyzing uses of NASA's overall capabilities. The development of this methodology was evolutionary in nature, starting with an initial methodology concept based on matching user needs, priorities, and goals with NASA capabilities to determine the relevancy of NASA capabilities in solving potential user problems. Then by overlaying the appropriate constraints (for example, environmental, economic,

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* Other contracts were let to consider uses and users in the commerical, foreign, and institutional sectors.

budgetary, and technical factors) which, at least potentially, inhibit meeting the future needs of the country, relevant and beneficial uses of NASA capabilities can be identified. The four tasks which led to the construction of the final methodology are described in the following paragraphs.

1. Task 1 -- Development of Methodology

Using the system illustrated in Fig. I-1 as a starting point, SRI developed a methodology for identifying potential users and uses of the Space Transportation System (STS) within governmental agencies (other than NASA and DoD). The physical output of this task was the flow chart shown in Fig. I-2. The methodology developed uses SRI's investigation of alternative cultural and economic futures to assure the feasibility and validity of the approach in an environment of time-dependent organizational goals and priorities. It also utilizes the results of SRI's efforts to determine the appropriate nature of the NASA/user interface.

2. Task 2 -- Operational Characterization

For the methodology developed in Task 1, SRI documented the nature of each required input, described each functional block in the methodology and the characteristics of the interactions between the functional blocks. The main purposes of this task were: (1) to characterize the methodology to a point where its practicability, validity, and germaneness were recognized, and (2) to identify those tasks necessary for subsequent implementation of the methodology.

3. Task 3 -- Management Information System

SRI also determined the characteristics of the information system needed to match potential users with NASA capabilities.

4. Task 4 -- Input Data Base

To the extent possible within the level of effort of this study, SRI identified specific user goals and priorities, NASA capabilities, and external constraints (see Fig. I-1) to be used as input data for the user and use identification system.

BASIC PROGRAM METHODOLOGY

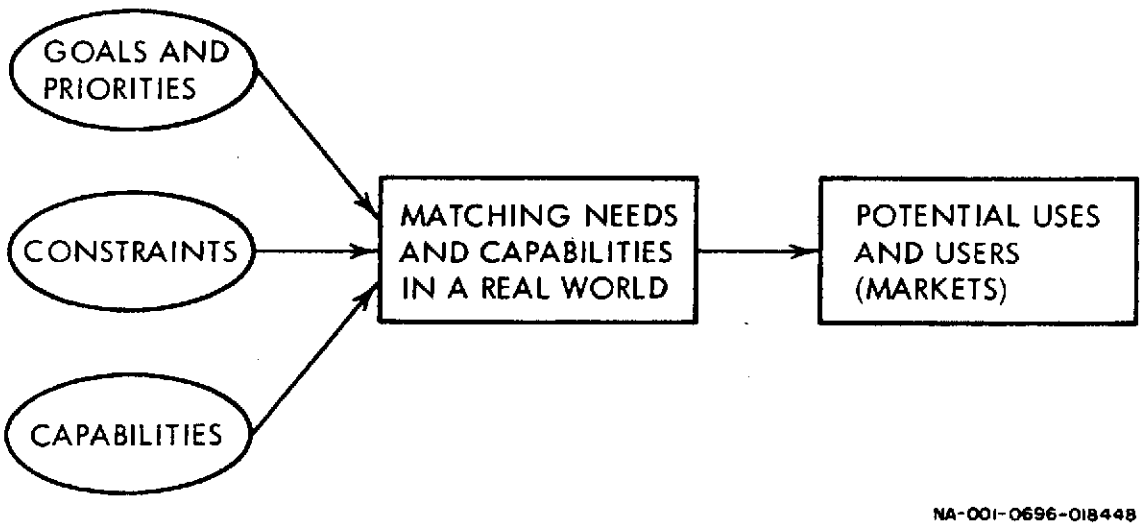

FIG. I-1 BASIC PROGRAM METHODOLOGY

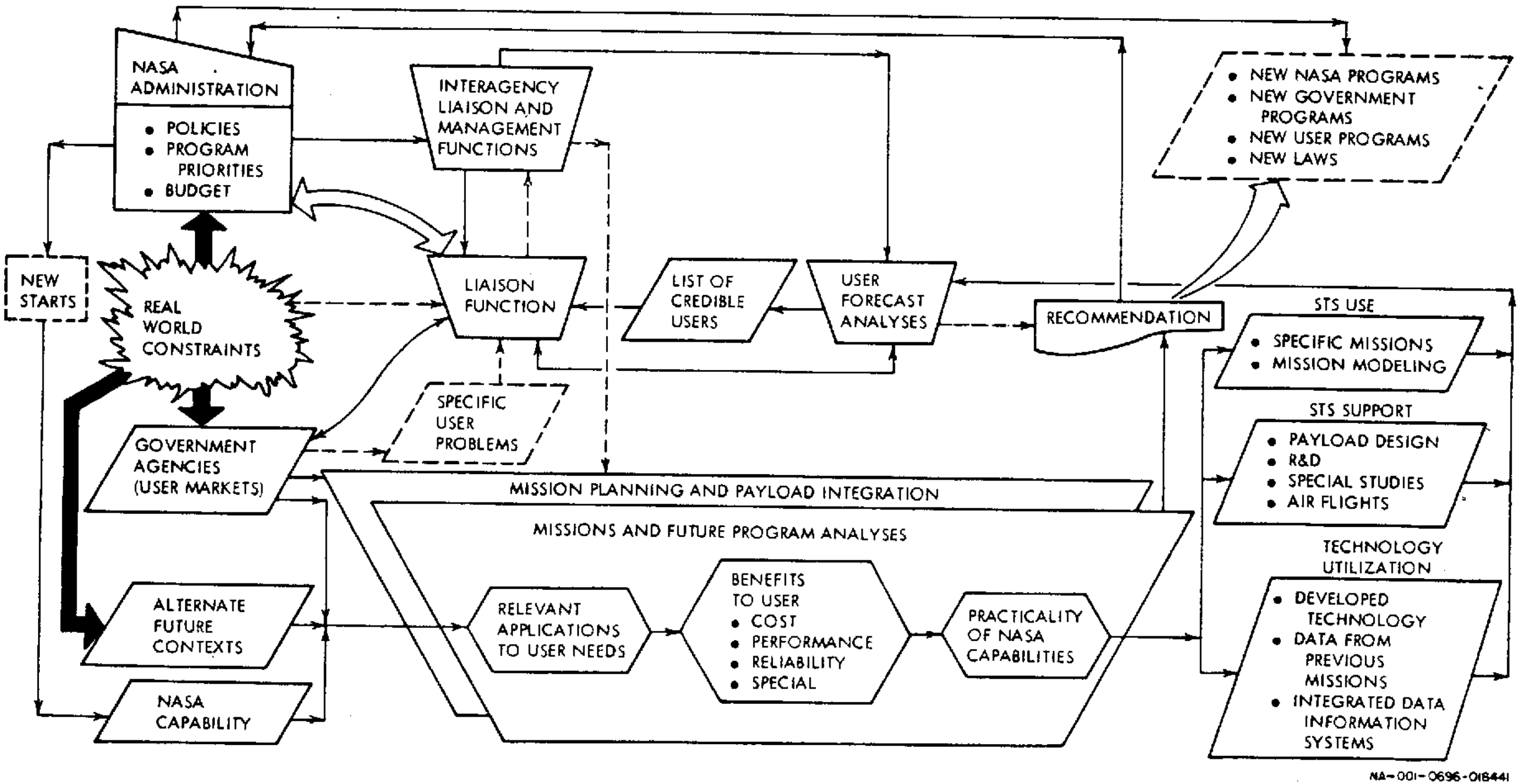

FIG. I-2 THE METHODOLOGY

D. ORGANIZATION OF REPORT

This report, which documents the results of the SRI study effort, is arranged in five main sections supplemented with two appendices. This section, Section I, constitutes the Introduction. The summary and recommendations of the study are given in Section II.

Early in the development of the methodology, it became clear that, if the methodology were to have validity and relevance over the entire life time of the STS, explicit consideration would have to be made of future environments in which the STS will be operating. Appendix A and Section III contain the results of the SRI investigation to determine how future environments should be incorporated in the methodology.

Also early in the study, it was recognized that successful operation of the methodology would require an effective interface between NASA and potential users of the STS. Section IV and Appendix B document the results of a study to characterize this interaction.

The last section of this report, Section V, contains a detailed description of the methodology developed in the SRI study.

E. RESTRICTION OF STUDY TO CONSIDERATION OF THE FEDERAL GOVERNMENT

This study stresses the identification of new STS users and uses within only the federal government. State, county, and municipal governments are not included because SRI concluded early in the study that the uses of the STS relevant to these "local" governments were included as a subset of the uses to be identified within the federal government. This conclusion was based upon the following observations:

(1) Each local problem that might be solved by use of the STS fits into an area where a federal program exists; for example, in the area of agriculture, education, communication, law enforcement, health, or land use planning.

(2) No specific problem of a local government is so peculiar to that locale that its solution is not of utility to other local governments.

(3) Both local and federal governments have agreed that the responsibility lies with the federal government for coordinating those programs which address the solution of problems of interest to several governmental users.

(4) There are efficient lines of communication between the federal and local governments, both for letting the local governments know what federal funds are available for solving problems of interest to local governments and for letting the federal government know what problems are facing local governments.

(5) SRI's experience in working with local governments has shown that one of their first concerns is the availability of federal funds to aid in addressing their problems.

Thus, it was concluded at the outset of the study that contact with the federal government would suffice to identify all new uses of the STS relevant to the entire domestic government sector.

During this study, no reason was uncovered for modifying this conclusion, except that occasional contacts with local governments are valuable in reality monitoring of societal values (see Section III,B,4). Since this interaction can be accomplished by a series of informal contacts, and is not central to the main series of tasks needed to identify new users and uses of the STS, no further mention of local governments will be made in this report: only interactions with the federal government will be discussed under the assumption that these interactions are sufficient to treat the STS uses of relevance to local governments.

II SUMMARY AND RECOMMENDATIONS

A. SUMMARY OF METHODOLOGY CHARACTERISTICS

This technical report presents a methodology that will permit NASA to identify new users and uses for the STS within the domestic government sector. The format of the methodology, however, is general enough to be used in identifying new users and uses of NASA capabilities other than the STS, both within and outside the domestic government sector.

This methodology provides for a viable interface which maintains an open, two-way communication link between NASA and potential government users. This interface should satisfy the two NASA objectives of: determining the needs, goals, and priorities of potential STS users; and identifying and/or developing interest of these groups in a potential use of the STS. One of the most important features of the interface is the requirement that NASA maintain continuing contact with the high-level policy makers of the potential and actual governmental users of NASA capabilities.

The overall methodology can heuristically be described as having three dimensions: an alternate futures dimension, a data processing dimension, and an analyses dimension. (See Fig. II-1 for a schematic representation of this structure).

The alternate futures dimension consists of those portions of the methodology which enhance the probability that those uses identified are appropriate for the time frame in which they become realized.* The discussions in Section III and Appendix A were used to structure the methodology to achieve this capability of operating in a changing environment.

* Because of the long time interval between the design and implementation of programs which apply NASA capabilities to the needs of a user, societal values that drive the goals and needs of the user at the time of program implementation frequently differ from those which existed at the time the program was designed.

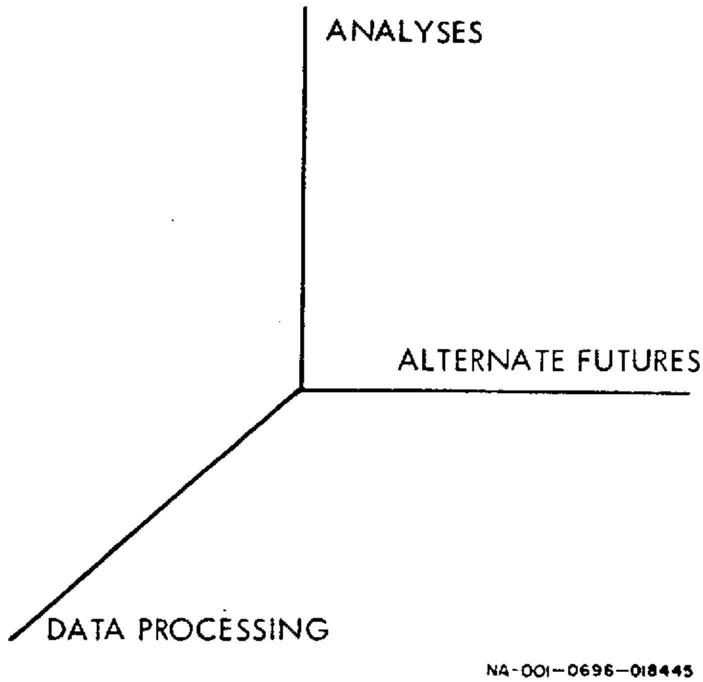

FIG. II-1 FUNDAMENTAL DIMENSIONS OF THE METHODOLOGY

The data processing dimension consists primarily of the input data for the methodology and a set of operations which act upon the input data to identify STS uses and users as a function of time. One of the most important aspects of the data processing dimension of the methodology is a series of three filtering operations which provide information on the relevance, benefits, and practicality of potential STS uses. The methodology has been structured so that these three necessary steps can be performed in any order.

The analyses dimension accounts for the use of the information generated in the data processing dimension. Specifically, it is concerned with who uses the information, and how it will be used. The analyses dimension includes not only the techniques for controlling data flow, but specifically provides and requires that appropriate personnel be involved in analyzing the data at various stages of data flow in the data processing dimension. The basic process involved in the overall methodology was shown in Fig. I-2. This figure also shows the basic data inputs and outputs of the methodology resulting from the data processing dimension. A key part of the analyses dimension involves taking the output data from the data processing steps and conducting a user forecast analysis to identify a list of credible users of NASA capabilities. This information is to be used by special liaison personnel who contact potential users from the policy making level on down to the technical working level in order to adequately provide a potential user the information informing him of the relevancy, benefits, and practicalities of using NASA's capabilities.*

The detailed methodology is discussed in Section V. In addition, that section presents four example user scenarios to illustrate the germaneness and completeness of the methodology, particularly in the data processing dimension. The specific examples treated are potential STS uses for:

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* It should be noted that the liaison personnel will be aware of the fact that potential non-users have been filtered out by the methodology: he knows he is talking to a genuine potential user.

(1) Controlling abusive drugs

(2) Disposing of nuclear waste*

(3) Discovering new energy sources

(4) Improving health care.

The results of applying the methodology to these cases verify its completeness and germaneness.

B. RECOMMENDATIONS

In the meetings conducted with potential governmental users of NASA's capabilities, it was observed that this user community is ready now to initiate talks with NASA on the application of NASA capabilities to the solution of their problems. Because of this user readiness and because of the long time intervals typically required between space program conception and operation, it is recommended that NASA immediately initiate the construction of a methodology, such as the one developed in this report, to identify users and uses of the STS (and other NASA capabilities, if possible). It is strongly recommended that the program to implement the methodology (or new user function) take cognizance of the three following design requirements, the need for which was borne out in this study:

(1) NASA must present a service or support oriented image to potential or existing users of NASA's capabilities.

(2) Alternate futures considerations must be included in the methodology.

(3) The identification of potential users and uses of a NASA capabilities must be made in an organized manner, and must be supported by NASA as an integral part of its overall planning function.

In order to implement the above recommendation for immediate construction of the new user function within NASA, it is recommended that

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* At the time this example was constructed, the authors were not aware of NASA activities addressing this same application. It was decided to retain this example in the report, however, in order to provide NASA an opportunity to assess the validity and completeness of the methodology through a comparison of the critical points identified in the example usage of the methodology with those identified by a different approach.

a Phase II effort be initiated as soon as possible. SRI recommends that this Phase II effort consist of performing four basic tasks: construction of the data base, generation of tools and techniques, training of NASA personnel, and exercising of the system. These four steps are essential to the implementation of a successful, operational new user function. The nature of these four tasks is described more fully below.

1. Data Base Construction

Proper operation of the NASA new user function requires the availability of information in three major areas outlined below. The data should be organized into a usable format with categories and key-word classifications being assigned.

a. NASA Capabilities

Both existing and potential NASA capabilities should be listed in terms of functions applicable to identifiable potential user applications. Ideally, this effort should cover all NASA capabilities; a bare minimum effort would concentrate on Shuttle-related capabilities.

b. Data on Potential Users

For proper operation of the NASA function a data base is needed which contains:

(1) A list of all potential users (government, commercial, etc.)

(2) The goals and priorities of each potential user

(3) The appropriate points of contact for each potential user, both at the policy-making level and at the technical working level

(4) The existing programs of each potential user in the areas where application of NASA capabilities appears worthwhile

(5) The past and present NASA interactions with each of the potential users

(6) The constraints (legal, etc.) peculiar to each user.

c. Futures Information

It has been shown that studies of alternate futures are relevant to the new user function. It is possible, for example, to determine

which NASA services or capabilities have applicability in a great number of possible futures and which ones have applicability in only a few futures. This information can be used to determine those NASA capabilities which should be stressed. Although SRI feels that a large amount of the futures work could be done within NASA, it is apparent that the initial study will have to be done largely by a contractor to NASA and the results reduced to an appropriate data set during the implementation phase of the program.

2. Generation of Tools and Techniques

a. Information Analysis

The large amounts of data to be generated and collected under Task 1 are useless unless the data are properly used. The ultimate use of the data is in the development of potential uses and users of the STS by NASA personnel. Operational tools and procedures for implementation by NASA should be developed to assure the availability of the data needed by the personnel staffing the new user function. This task will specifically involve the construction, as needed, of computer programs to aid in the rapid retrieval of appropriate data and in the development of a complete description of the information flow and analytical functions to be incorporated in the operational system.

b. Costing Analysis

Great importance has been placed by many of the potential users contacted on the cost aspect of any potential STS use for the benefit of a potential user. It is highly desirable, therefore, to have a tool which will permit the quick generation of estimated program costs (R&D and/or operational). The construction of such a tool is within the state of the art and should be undertaken to treat the complete set of potential uses for the STS. Existing NASA costing tools should be utilized in the assembly of this analytical tool.

3. Long Lead-Time NASA "Training" Activities

Implementation of this methodology will involve NASA personnel in two work areas that are somewhat new to NASA. These two areas are: futures

analyses and top-level liaison with potential users. Both these activities will be required in an operational new user function, but it will be necessary to train and exercise the appropriate NASA personnel before the NASA new user function is fully operational. Therefore, it will be necessary during Phase II to develop the appropriate skills within NASA.

4. System Exercising

The pre-Phase II assessment and integration of the Phase I activities will result in an initial definition of the NASA new user function. Such a definition must be made to permit a detailed work statement to be written for the Phase II efforts. As the contractors and NASA perform the implementation work of Phase II, it is anticipated that it will be possible to "do the homework" adequately to exercise the defined function prior to the Phase III operation. This "system exercising" activity is highly recommended and should be used to determine where modifications to the function are appropriate. Since the results of these exercises could well call for changes in the contractors' efforts, they should be attempted as early as feasible and should involve both NASA and contractor personnel.

As a necessary adjunct to the above tasks, it should be recognized that these efforts are meaningful only if the following strictly NASA-supported activities are performed:

(1) NASA operational software personnel and the necessary hardware for operating the computer programs must be made available.

(2) Commitments must be made and implemented for hiring new people and/or assigning existing NASA personnel to futures analysis and liaison activities.

(3) The responsibilities for the various subtasks of the new user function within NASA must be assigned to assure proper information flow among NASA people and offices during the operational phase.

If these three NASA initiated actions are taken, the four Phase II tasks outlined above will assure the construction of a viable and germane methodology for use in the operational phase (Phase III).

III THE ALTERNATIVE FUTURES DIMENSION OF THE METHODOLOGY

A. INTRODUCTION

The relatively long lead time between the conception and execution of major space programs imposes on NASA perhaps a greater need for knowledge of possible future envrionments (environments broadly considered to include the social, political, economic, and cultural aspects) than most operational, program-oriented agencies of government. Programs planned in the present environment and justified in terms of the apparent needs and priorities of this environment may not prove suitable to the needs of a number of possible futures that could evolve by the time these programs become operational.

In order to develop methodologies for identifying potential users and uses of the STS that would be viable for either short-range (5 years) or long-range (10 to 20 years) planning*, SRI-Huntsville's System Research Department collaborated with the Institute's Center for the Study of Social Policy to incorporate those factors which drive the goals, needs, and priorities of all government departments, agencies, commissions, and special offices.** The driving factors identified were current national and international economic, political, and social environments. Since these environments are continuously changing as social values and attitudes change, and since NASA has little opportunity to influence the determination of these values, the alternative furtures dimension of this methodology is designed to identify changing environments which will affect the relevancy

* Trends indicate this long-range planning is becoming more and more necessary.

** The Center for the Study of Social Policy has been conducting research of this type for major U.S. industries as well as government agencies such as the Congressional Research Service, the Office of Technology Assessment, and the U.S. Office of Education.

and benefits of NASA's capabilities to government agencies. This dimension will not by itself determine the future opportunities that will be available for matching potential users with NASA's capabilities, but will be useful for planning viable programs for NASA in the future.

The process by which the futures data is derived is discussed in Section B below. The use of the data in the overall methodology is discussed in Section C.

B. DERIVATION OF FUTURES DATA

The data output from the alternative futures dimension, or futures forecasts, is an input to the overall methodology for identifying potential users and uses of the STS, and is derived through a series of steps that have to be reiterated periodically. The five steps are: (1) probing the future, (2) analysis of the content, (3) formulation of strategy based on the analysis, (4) monitoring reality, and (5) modification of the strategy. This section attempts to define the alternative futures dimension of the overall methodology presented in this study as concisely as possible. A much more expanded version of this material is included in Appendix A.

1. Probing the Future

a. Describing the Possible Futures

The first stage in developing an alterna /e futures dimension is the identification of one or more comprehensive definitions of distinct alternative futures, generally some form of narrative description of a possible state of affairs in a given society at some future time. Usually, the time is fifteen or more years from the present. For this study, two probable alternative futures, designated Post-Industrial I and Post-Industrial II, were drawn from existing futures research ongoing at SRI's Center for the Study of Social Policy. These futures essentially are updated versions of a set of alternative futures derived by the

Field Anomaly Relaxation Method (FARM)*, and their selection was based on their greater probability and their usefulness in illustrating the methodology. Both futures (or slightly different variants thereof) appear consistently in futures literature, and both are generally considered normative.**

Only two futures were considered to permit greater depth of analysis of each. However, in applying the methodology described in this section in a real-world situation, continuing probing effort will be required and the planner will have to deal with the complexity that will imposed by greater breadth, as well.

The two futures chosen to illustrate the futures dimension in this report are described in the following paragraphs.

1) Post-Industrial I Future

The Post-Industrial I future is one in which current industrial-age values, modes, and institutions are accepted, heightened, reinforced, and adapted to provide an accelerated rate of technological and scientific development. This future emphasizes consumption, quantitative economic growth, competition, and morally neutral science. Based on current trends, these characteristics will be adapted or limited by supplies of natural and economic resources, and atmospheric pollution considerations.

2) Post-Industrial II Future

The Post-Industrial II future is one in which industrial-age values, modes, and institutions are largely rejected, modified, and replaced, partly in response to accelerated technological and scientific

* This technique consists of a variety of processes, including: construction of systematic alternative "future histories;" trend projection; historical analysis and analogy, and collective informed opinion and insight (e.g., Delphi).

** Had the study dealt with any of the less desirable or most undesirable futures, the environments illustrated for the space program's future might have been very different.

development. This future emphasizes frugality and conservation, economic growth through optimization, cooperation, and socially responsible science. The ethic of the Post-Industrial II future is basically: (1) an ecological ethic emphasizing the community of man in nature and the oneness of humanity, and (2) the self-realization ethic emphasizing the development of individual human potentialities.

b. Definition of Primary Characteristics

After the distinctive features of the alternative futures have been described, the final step in the probing stage is the definition of primary characteristics distinguishing one future from another. For this study, ten primary characteristics were identified for each future. They are enumerated below.

1) Characteristic Values of Post-Industrial I Future

The following values were inferred from the description of the Post-Industrial I future presented in the previous section:

(1) High value placed on consumption
(2) High value placed on objective and pragmatic reality
(3) Acceptance of decisionmaking power by a meritocratic elite
(4) High value placed on quantitative economic growth
(5) High value placed on nationalism*
(6) High value placed on institutional survival
(7) High value placed on competition
(8) Education valued as means of training and socialization
(9) Knowledge considered as property
(10) Science considered value-free and morally neutral.

2) Characteristic Values of Post-Industrial II Future

The following values were inferred from the description of the Post-Industrial II future presented in the previous section.

---

* Certain trends, such as the development of multinational corporation, make the survival of this value less than certain in this future.

(1) High value placed on frugality and conservation

(2) High value placed on subjective reality

(3) High value placed on an open, participative power structure

(4) High value placed on optimization of the economic system--qualitative growth

(5) High value placed on supra-nationalism and localism

(6) High value placed on institutional change and flexibility

(7) High value placed on cooperation

(8) High value placed on education as contributing to personal growth and fulfillment

(9) High value placed on privacy with equal value placed on free and open dissemination of knowledge*

(10) Requirement for social responsiveness of science.

2. Analysis of a Future's Content

a. Contrast List

The first step in analyzing the content of possible futures is to prepare a list which allows one to pair corresponding characteristics of the futures considered. By pairing the primary characteristics of the two futures treated in this study as shown in Table III-1, a set of issues that can be monitored emerges. The resolution of these issues determines the societal trend. For example, to the extent that societal behavior currently supports frugality rather than consumption, the likelihood of a Post-Industrial II future is enhanced. Most of the information available for monitoring will be cast in terms of such contrasting issues.

b. Conflict Matrix

Elements of both alternative futures treated are present in the current era. The immediate future, therefore, is viewed as a transition period in which the values of both futures will be present, probably with elements of one dominant and then those of the other. Under these circumstances, it is appropriate for a space program to be structured so as

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* The two apparently conflicting elements seem to contribute to a unity.

Table III-1

CONTRASTING PAIRS OF VALUE CHARACTERISTICS

Characteristic of Post-Industrial I Future		Characteristic of Post-Industrial II Future	
1A:*	High Value on Consumption	1B:*	High Value on Frugality and Conservation
2A:	High Value on an Objective and Pragmatic Reality	2B:	High Value on Subjective Reality
3A:	Decisionmaking by a Small Meritocratic Elite Group	3B:	High Value on an Open, Participative Power Structure
4A:	High Value on Growth	4B:	High Value on Optimization Instead of Growth
5A:	Nationalistic Values Dominate	5B:	High Value on a Supra-National Community
6A:	Permanence of Institutions	6B:	High Value on Institutional Change and Flexibility
7A:	High Value on Competition	7B:	High Value on Cooperation
8A:	Education Valued as Training and Socialization	8B:	Education Valued as a Contributor to Personal Growth and Fulfillment
9A:	Knowledge Considered as Property	9B:	High Value on Personal Privacy with a Requirement for Free and Open Dissemination of Knowledge
10A:	Value-Free (Morally Neutral) Science	10B:	High Value on Socially Responsible Science

* These alpha-numeric codes were assigned to the value characteristics for use in further analyses. Post-Industrial I values are indicated by an "A" preceded by a number; Post-Industrial II values are indicated by a "B" preceded by a number.

to contribute positively to the values of both possible futures. Otherwise, any space program will periodically be vulnerable to cancellation because of its lack of relevance to the values of the dominant ethic. The contrast between the characteristic values of the two futures as shown in Table III-1, however, would make it appear that it is impossible to place a program that could be justified in the context of both these futures: a justification based on the positive contribution in a Post-Industrial I environment would apparently be viewed as countervalue oriented in a Post-Industrial II context. As demonstrated by the discussion in Sections 3,a,1) and 3,b,1) of Appendix A of this report, however, some commonality does exist in the opportunities afforded in these two futures; in fact, even in those opportunities offered by a single pair of contrasting values. Thus, it is clear that a study of the opportunities (and restraints) is needed for final determination of the suitability of a given NASA program: perusal is needed of these items <u>derived</u> from the value characteristics rather than the value characteristics themselves. Sections c and d, which follow, discuss the opportunity/restraint analysis which will allow this determination to be made. However, an initial test of the applicability of a given program simultaneously to both futures is possible in terms of the value characteristics. This technique is outlined below.

Table III-2 is a matrix which expresses the conflicting or supportive relationships between the various value characteristics of the two different futures.* A plus (+) entry in a given square indicates a supportive or, at least, a non-conflicting situation. For example, Objective Reality (2A*) is not in conflict with Thrift (1B). A minus (-) entry indicates a conflicting situation. For example, Growth (4A) seems to be in conflict with Thrift (1B). Where the situation is unclear, a question mark (?) is entered.

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* The characteristics in Table III-2 are labeled by the number/letter designation assigned in Table III-1 where Post-Industrial I items bear the letter A and Post-Industrial II items bear the letter B.

Table III-2

ANALYSIS OF CONFLICT BETWEEN VALUE CHARACTERISTICS
OF DIFFERENT FUTURES

Value Characteristic of Post-Industrial I Future		Value Characteristic of Post-Industrial II Future									
		1B	2B	3B	4B	5B	6B	7B	8B	9B	10B
	1A	–	+	+	–	–	+	–	–	?	+
	2A	+	–	+	+	+	+	–	–	–	–
	3A	+	–	–	+	+	–	–	–	–	–
	4A	–	+	+	–	+	–	–	–	–	+
	5A	+	–	–	+	–	–	–	–	–	–
	6A	+	–	–	+	+	–	–	–	?	–
	7A	+	+	+	–	–	+	–	–	+	–
	8A	+	–	–	+	+	–	+	–	–	+
	9A	+	+	–	–	–	+	–	–	–	–
	10A	–	–	?	–	+	+	–	–	–	–

+ = No conflict apparent

– = Conflict apparent

? = Uncertain

The utility of this table in program planning during the upcoming transition period lies in its ability to identify those aspects of a proposed program that adapt well to either future, and thus, those for which planners can expect support. Accordingly, the matrix also indicates areas of possible conflict for which the program planner must incorporate alternatives or instigate plans for changing confiicts into assets. For example, a program which can be characterized as being dominantly supportive of Growth (1A) in the Post-Industrial I future can probably gain support in a Post-Industrial II environment by being structured to support the value characteristics 2B, 3B, 5B, and 10B; for example, in part by being structured to be socially responsible (10B). On the other hand, particular attention will be required to minimize the countervalue nature of such a growth-related (1A) program with regard to 1B, 4B, 6B, 7B, 8B, and 9B; for example, the program should be structured to serve as much of the user community as possible in order to avoid conflict with the high value placed on cooperation in a Post-Industrial II context (7B).

c. Definition of Opportunities and Restraints

The next step in analyzing the content of a particular future is to derive sets of opportunities and restraints for the space program from each value in each future. For example, in Post-Industrial I a high value is placed on personal consumption. Thus, opportunities for the space program can be seen in developing capacities for: (1) seeking out new sources of raw materials; (2) development of new high productivity technology; (3) the monitoring of global traffic in commodities; (4) providing high-skill, high-pay jobs for consumers; and (5) acting as a symbol of conspicuous consumption. Restraints deriving from this value are: (1) competition with consumer goods manufacturers for materials; (2) taxation of consumers to pay for the program; (3) inability to provide consumer goods directly.

In Post-Industrial II, the contrasting value is expressed in terms of an emphasis on frugality and conservation. This value provides opportunities growing out of space program capabilities in:

(1) monitoring sources of materials; (2) the use of advanced technology for non-polluting and non-destructive activities. A restraint is seen in the fact that the spectacularly apparent consumption of raw materials in the space program is inconsistent with the frugality-conservation ethic.

d. Sorting Opportunities and Restraints by Probability

The last step in content analysis is to sort opportunities and restraints by conditional probability. This results in ordering the probabilities. In this study, a "first-order" designation results when an opportunity or restraint can be derived from characteristics of both alternatives. A "second-order" designation indicates that more than one opportunity or restraint can be derived from characteristics of one alternative future only. The final category, "third-order", includes all other opportunities or restraints regardless of what qualitative value might be assigned to them.

This opportunity/restraint dichotomy can be used in several ways within the overall methodology. It has to be emphasized that these involve, as did the derivation and analysis of the futures, largely subjective processes. In the final analysis, all estimates of situations in which human beings, their preferences, and the social expression of those preferences play a part are highly subjective in process and result. Systematizing the process, as has been attempted in this study, is one means for dealing with this reality and increasing the probablity of arriving at a more nearly objective result. Especially during a period of transition to a range of possible futures, use of the dichotomy assists the planner in identifying aspects of his program that adapt to either (or more that one) and for which he can expect to find future support. Where conflict is indicated, he can prepare alternative programs or approaches.

3. Formulation of Strategies

The strategy which is employed to take advantage of the information available to the planner at the end of the previous step (Analysis of a Future's Content) should be a dynamic one that is modified appropriately

as circumstances dictate. An appropriate first strategy to be employed in the methodology is described in the following paragraph.

Concentrating on first-order opportunities, since these will be manifest to some degree in the transition period, the planner selects programs that will be, to the greatest degree possible, responsive to those opportunities while concomitantly assuring responsiveness to restraints of all three orders. He also seeks support from those agencies whose opportunities and restraints complement his own. The scenarios presented in Section V of this report reflect the use of this strategy.

4. Monitoring Reality

Space program liaison personnel working with other government agencies are essentially the implementors of the strategies derived in 3 above. An important part of their task is the gathering of trend information related to the futures; the planning strategies are based on the trend information. Their reports are basic to the content analysis of step 2. The results of this step are used as input to step 5 below.

One simple device for tracking a set of indicators is the contrasting pairs list of Table III-1. If any of the issues identified in the content analysis appear to be resolving in favor of one or the other of the characteristics assigned to an alternative future (or, for that matter, in a manner negative to both), the probability of either future can be determined more closely.

5. Modification of Strategy

This step involves the modification of the strategies devised in step 3 above to reflect revised estimates of the situation. For example, if reality monitoring provides input that resolution in favor of a specific future is underway, the strategy should be modified to allow for the utilization of appropriate second-order opportunities.

C. USE OF THE FUTURES DIMENSION IN THE OVERALL METHODOLOGY

The futures dimension is used in the overall methodology to:

(1) Eliminate or minimize the number of high-risk space programs while maximizing the number of low-risk programs to be considered by the planners.

(2) Aid in identifying future social benefits of NASA's capabilities that will not conflict with social programs already designed to solve these social problems.

(3) Identify new opportunities for use of NASA's capabilities in conflicting environments in the future.

(4) Predict a credible list of users and uses for the STS.

In order to accomplish the purposes of the futures dimension, the data input from the alternative futures studies--input which is constantly changing as social trends change--must be analyzed in an iterative process before they are input into the overall methodology. The data from the alternative futures studies are used as input in accomplishing four basic tasks in the overall methodology:

(1) The opportunity/restraint analysis results are used in compiling the initial Prioritized Users/Needs List (see Section V,D,1,b) to minimize the number of high-risk programs considered by the planner (purpose 1 above).

(2) The futures data are input to the Relevancy Filter (see Section V,D,1,d) to match NASA capabilities with potential users' needs to accomplish purpose 2 above.

(3) The probability data from the alternative futures studies are used in Users Forecasting by program analysts (see Section V,D,2) to identify new users of NASA capabilities in the transition period when the future is undecided or to use in planning viable programs when the future can be determined, but when social dissenters have significant influence over program survival or orientation (purpose 3 above).

(4) Finally, the alternative futures data are used in the Reality Monitoring and Strategy Planning operations of the overall methodology (see Section V,D,2) to compile a credible list of potential users who will be contacted to initiate uses or new programs for the STS (purpose 4 above).

IV NASA/USER INTERFACE

A. INTRODUCTION

The overall study documented in this report is concerned with the development of a methodology for the identification of new users and uses for the STS within the domestic government sector. (See Section V for a detailed description of this methodology.) This development consisted of specifying the functions to be performed by NASA personnel (or contractors to NASA), as well as the types of data needed as input to the data processing and analysis steps which make up the methodology. These data processing and analysis activities are meaningless, however, unless an effective interaction exists between NASA and potential users.* Without such interaction, the currency and validity of the input data on the needs, goals, and priorities of potential users would be suspect. In addition, the absence of an effective interface between NASA and potential governmental users markedly degrades the probability that the potential uses identified will ever be implemented.

In view of these observations, SRI personnel have attempted to determine the nature of an effective and viable interface between NASA and potential governmental users that will satisfy the following two primary requirements:

(1) The interface must provide currently valid input to NASA regarding the goals, needs, and priorities** of potential STS users within the domestic government sector.

(2) The interface shall provide a means to develop interest within the potential user agency for transforming a potential use into a reality.

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* The importance of this activity has been recognized in other studies undertaken to identify new STS users and uses such as the G.E. BUS study mentioned in Section I of this report.

** These items will determine the programs to be undertaken by these agencies and will be changing in time (see Section III). Thus, relevancy of potential uses requires current and valid knowledge of these points.

Although the characteristics of the interface to be determined are those that should be implemented by NASA in the overall methodology (that is, only NASA-initiated actions are being considered), it was felt that it was appropriate to determine, from interviewing a sampling of potential users, what kind of interface would be most effective and viable from a potential user's viewpoint. Inasmuch as the two numbered items above specify the NASA-based requirements. it was felt that the input from potential users would permit the definition of an interface which would satisfy these requirements in the real world.

Therefore, a series of meetings was scheduled by SRI with potential governmental users to determine their views on what would be a viable NASA/user interface. The contents of the nine meetings held with agencies in and around Washington, D.C. in January and February of 1974 are documented in moderate detail in Appendix B of this report. As a result of these meetings, several conclusions were drawn as to the nature of an effective interface which will satisfy the NASA requirements. These are summarized in the following paragraphs. The reader is referred to Appendix B for a more detailed discussion which lends fuller credence to the validity of these points.

B. MAJOR CHARACTERISTICS

1. Data-Gathering Activity

Interviews with various government agencies revealed that the long-range plans of most of the potential government users of the STS have not been documented. Moreover, it was found that the agency goals and priorities of interest in the operational time frame of the STS are not well organized outside the minds of people in the policy-making offices of these agencies. Therefore, complete determination and monitoring of potential user goals, needs, and priorities must necessarily involve personal interactions with individuals at the policy-making level within the potential user organizations.

This does not mean that no other sources of information are available -- quite the contrary. Newspaper articles of speeches given by members of the government agencies in question, engineering society

proceedings, government reports summarizing governmental research activities, and records of congressional committee hearings are all good sources of information for the data base, as are personal contacts between personnel in NASA and the potential user agencies at the technical working level. However, SRI personnel, working out of the Washington Office, have found that the currency and completeness of this information cannot be guaranteed without the use of personal contact at the policy-making level.*

2. Potential Use Development Activity

Implementation of the data-gathering activity outlined above permits NASA to identify potential uses of the STS that are relevant to potential government users. Following this identification, contact with the potential users should be made in order to develop interest in implementing these uses. The desired nature of this contact was at least partially determined in the nine meetings conducted by SRI personnel in and around Washington for this study. The primary findings of these meetings relevant to developing potential user interest are given below.

a. Image

Without exception, the offices contacted expressed the opinion that any interaction between NASA and a government user must be conducted in an atmosphere in which NASA approaches the potential user in a supporting role. That is to say, that in the interaction between NASA and the potential user NASA should demonstrate a knowledge of the potential user's goals and priorities and the specific needs for accomplishing these goals. NASA should be able to positively state its capabilities which can help the user satisfy those needs for attaining his goals. Such an approach permits NASA to be identified as a partner in the attack on the problems facing the potential user, and leaves the direction and responsibility

* Several people at SRI-Washington and within the government agencies contacted were asked if a list of documents could be compiled that would yield the desired information. The answer was a resounding "No." One reason specifically given for this answer was the observation that by the time the definition of a need gets into print, a solution is already in sight.

for the overall problem solving program with the potential user. Such an approach requires, however, that the NASA representative be able to converse with the representative of the user agency in terms that both understand and that he be well informed as to what the goals, needs, and priorities of the user are.

b. Points of Contact

After a decision has been made within a potential user organization to pursue a specific program using NASA capabilities, it is appropriate for the technical personnel of both NASA and the potential user to work together to bring the potential use into operation. Such contacts have been made and used for years. They should be continued.

There is, however, a higher-level contact which is also needed. Inasmuch as any decision to implement the STS for a specific user involves questions of that organization's budget, manpower allocation, and perhaps even organizational structure, NASA must have some interface at the policy-making level within the user organization. Such interaction has several advantages. First, a positive decision at this level to pursue development of a potential use yields a high probability of eventual implementation. Second, it reduces the time for a decision, either positive or negative, on implementing any single potential use. Third, continuation of such an interface: (1) provides a single point of contact through which major program problems may be resolved rapidly; (2) assures longevity of the NASA/user interface;* and (3) satisfies the requirements of NASA in the data-gathering activity described above.

However, in order to take advantage of the benefits of this high-level interaction activity, the NASA representative must be assigned to these responsibilities for the long term to preserve continuity. The NASA representative must also be able to gain access to the office of the appropriate policy planners within the potential user's organization. Also, since the appropriate point of contact may be as high as an

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* Thereby enhancing NASA's image as a long-term partner in the solution of problems other than its own.

Assistant Secretary (as in the Department of Transportation and, perhaps, the Department of Agriculture), at least some of these liaison personnel should report directly to the Office of the Administrator at NASA. Any lower position in NASA's organizational structure reduces the possibility of conducting substantive discussions with members of an Assistant Secretary's office on a regular basis. This peer status would also be valuable in contacts outside the office. Additionally, to take full advantage of the high-level interaction postulated, the high-level NASA personnel must be recognized within NASA as the primary point of contact with the user, just as it is desired for the policy planner in the user organization to recognize him as such. In order to create this credible image, high-level liaison personnel should have available the following support:

(1) He should be able to get support from the NASA technical staff, as needed, to answer questions posed by the policy-planner of the user organization.

(2) A procedure should be formally initiated which supports technical follow-ups on promising leads uncovered in his contacts.

(3) He should have the power to ask for a project review, if it appears that the project is in trouble.

(4) He should be informed of the progress on each current project which supports the specific user for whom he is the primary point of contact.

This support is necessary to allow the liaison men to function in a manner similar to that of a project leader in a contract research organization. It goes without saying that the responsibilities assigned to these men, although not completely outlined here, justify the level of support called for above.

c. Content of Contacts

The interaction between NASA's technical personnel and those of the user should have no restraints; they should be free to discuss not only the existence of, but the need for, further NASA support of the user. However, it is recommended that any such discussions on the need for further NASA support be reported to the high-level liaison representative, so that a single, primary point of contact can be maintained.

As indicated by the above discussion of the nature of the high-level interaction, it is not necessary that the high-level interaction include very much technical content: first, because it may well be that the high-level policy planner of the user organization is not a technical man, and secondly, even if he is, the potential user is not interested in a discussion of the technology but an identification of what NASA capabilities can do to solve his problems.

Just as assigning a single point of contact within NASA for each governmental user affords advantages in efficiency and reflects the desires of the potential users, it was found that the interactions with potential users should take not only the capabilities of the STS into account, but the capabilities of NASA as a whole. This is not only efficient; it is the preference of the potential users contacted by SRI in this study.

d. Cost Estimates

Without exception, the potential agencies contacted said that one of the most important considerations that would have to be included in any decisionmaking process concerning the use of NASA capabilities was cost. In this regard, a comparison of costs (both initial procurement and operating costs) was deemed necessary very early in the decisionmaking process when more than one possible solution to a problem existed. Such a cost comparison may involve consideration of alternate solutions based on different NASA capabilities. Thus, it is recommended that all of NASA capabilities be treated in the high level interaction with the user organization. When unique opportunities are afforded by NASA capabilities for meeting the goals of a user organization, the cost benefits should also be stressed, though they may be highly subjective. Even in this latter case, the potential users contacted by SRI in this study indicated that costs and benefits will be considered very early in the decisionmaking process.

Under the circumstances outlined in the previous paragraph, it is imperative that NASA be able to give rapid and credible cost estimates for each potential use of the STS, or any other NASA capability, discussed with potential users.

C. MISCELLANEOUS FINDINGS

In addition to the findings given above, which are considered major in the sense that they directly affect the structure of the methodology that is described in detail in Section V, the meetings between SRI and the nine agencies listed in Appendix B also led to the following observations:

First, Research and Development (R&D) funds of the potential user agencies are limited; the majority of the funds at the disposal of these agencies is for operations. Thus, the largest potential for the use of NASA's capabilities lies in the operational phase of activities of a user. In addition, the term Research and Development has different meanings for NASA and some of the potential users. There is very little work supported by potential users that NASA would call research; what these users call research is more nearly what NASA calls development, and the high-level liaison personnel must learn to make this distinction.

Secondly, the users already have a general knowledge and appreciation of NASA capabilities. However, the potential users also have some ideas as to what NASA capabilities cannot do for them. For example, several potential users have pointed out that the resolution afforded by the Earth Resource Technology Satellite (ERTS) imagery is insufficient to meet their needs. There is, however, an intense users' interest in talking to NASA representatives to see if their needs can be met by a similar program using the STS or some other NASA capability.

Thirdly, SRI's interviews indicate that the potential users are ready now to talk with NASA concerning what NASA can do for them in their attempts to meet their goals, as long as this interaction reflects the characteristics outlined previously in this section.

Lastly, the industry associations (such as the American Gas Association and the Petroleum Institute) will probably serve as a good source of information on potential uses on which these organizations would be happy to work with NASA in developing governmental interest for their implementation.

V METHODOLOGY FOR IDENTIFYING STS USERS AND USES

A. GENERAL

The methodology developed in this study was designed to identify new users and uses of the STS. In contrast to other studies, this methodology consists of a series of analytical techniques and well-defined functions (including direct interfaces between NASA and users) structured as an organized planning process to assure efficient and meaningful use of the STS. The derived methodology has proved to be of direct utility to other NASA capabilities by being adaptable to organized planning activities for both current and future programs.* Previous studies such as General Electric's BUS[2] studies used only a direct interface or dialogue methodology to identify new uses. The BUS methodology employed no set formulas, but rather involved individual contact with potential users. Aerospace Corporation's BRAVO studies used a methodology "involving the optimization of satellite designs in terms of reliability and cost, identification and selection of practical satellite system maintenance strategies, and comparisons of space and ground systems in clear and meaningful terms."[3] These considerations are included in, but form only a portion of, the methodology documented in this section.

The methodology defined in this study is an organized process that will permit NASA to: (1) realize efficient and economic use of the STS and other NASA capabilities, (2) identify new users and uses of the STS,

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* In fact, much of this section is written in terms of considering not only the application of the STS to the solution of potential users' problems, but also the application of the entire spectrum of NASA capabilities. Should specific restriction to STS uses be desired, this can be accomplished by the imposition of constraints on the input data base or by the use of a filter within the methodology. However, because of the expressed desire of potential users to interface with NASA on a basis where all NASA capabilities are treated, and in view of the ease with which the non-STS capabilities could be incorporated into the methodology, it was decided to present several aspects of the methodology in a form of more general utility.

(3) contribute to organized planning activities for both current and future programs, and (4) aid in analyzing uses of NASA's overall capabilities. The development of this methodology was the prime concern of Task 1 of this study.

The development of this methodology was evolutionary in nature, starting with an initial methodology concept based on matching user needs, priorities, and goals with NASA capabilities to determine the relevancy of NASA capabilities in solving potential user problems. Then by overlaying the appropriate constraints (for example, environmental, economic, budgetary, and technical factors), relevant and beneficial uses of NASA capabilities are identifiable. Figure V-1 shows the most basic concept of the methodology.

The final form of the methodology, discussed in Section D, will be schematically shown in terms of a flow diagram, depicting not only the flow of data generated by the initial methodology, but also the use of the data by user analysts in functional form. Characteristics of the individual blocks in the flow diagram are defined and discussed in detail below. The management information system, required to provide the capability to catalog and control the vast quantity of information on the user community for the purpose of selecting uses of benefit to potential users, is also described below.

B. METHODOLOGY DESIGN REQUIREMENTS AND GUIDELINES

In any effort to identify potential users for NASA's capabilities, it is important to recognize what NASA has to offer potential users. Clearly, NASA's experience in space operations, supporting earth-based operations, and hardware development constitutes the basic foundation of these capabilities. Using these factors as a basis, it is possible to identify those unique "functional services" that NASA can provide. Such services include monitoring the Earth from space, delivering spacecraft to orbit, and delivery of supporting functions on Earth, such as spacecraft design, data handling, etc. These capabilities are discussed in greater detail in paragraph C,2 (Input Data Base).

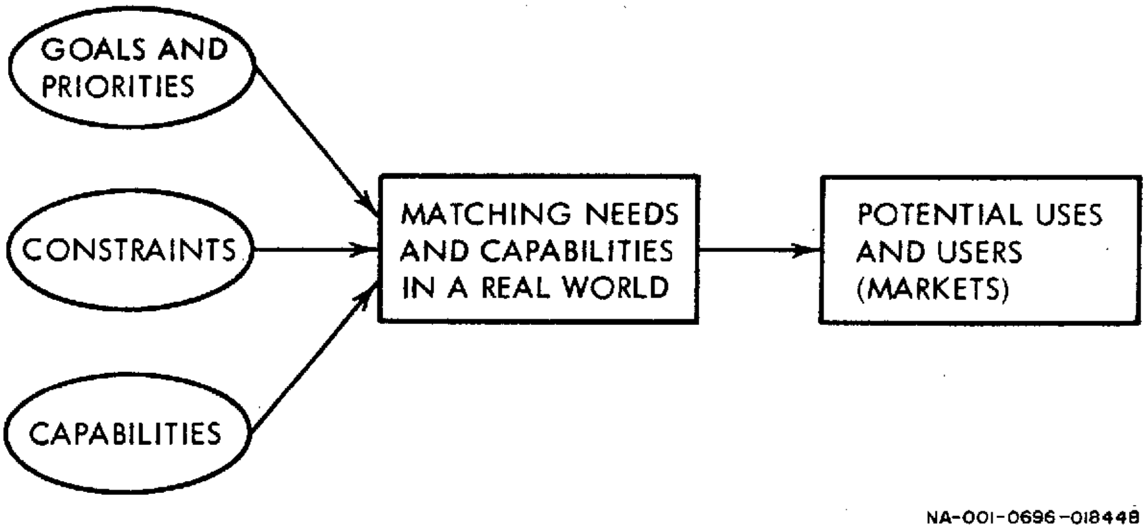

FIG. V-1 BASIC PROGRAM METHODOLOGY

In addition, given the long lead times for realizing future programs and future applications of NASA capabilities, it is necessary that the methodology include a futures dimension that permits a formal analysis of the many possible alternate future contexts in which planned space programs could be operating. This is of particular importance since programs undertaken now for the application of NASA capabilities to governmental or other users will be required to remain relevant and useful in their operation in tomorrow's environment. The use of an alternate futures context makes the methodology flexible and responsive to current, future, and changing environments determined by social goals, needes, attitudes, and priorities. The use of the alternate futures dimension in the overall methodology is discussed in detail in Section III, and Appendix A discusses the development of this dimension.

Several other requirements of fundamental importance in designing a methodology for identifying potential uses and users of NASA capabilities are listed below. The methodology must contain:

(1) Considerations cognizant of, and responsive to, real-world budget constraints in current and future environments

(2) Appropriate functions to make the methodology usable by NASA personnel both in liaison and analysis functions

(3) Provisions to keep the methodology consistent with NASA policies in using NASA capabilities

(4) Provisions to realize planned technical activities consistent with current and future technical realities

(5) A data management system capable of providing a convenient means of determining efficient and beneficial uses of NASA's capabilities.

In utilizing these design requirements, it was convenient to define the methodology in terms of a structure having three dimensions:

(1) A data processing dimension which essentially accounts for the basic information required for identifying potential uses and users of the STS and other NASA programs (the matching of needs and capabilities)

(2) An alternate futures dimension that essentially identifies the future environments in which planned programs will operate

(3) A data analysis or data use dimension that essentially identifies the functions the user analyst must perform to properly use the input data and the alternate futures considerations in his attempts to identify credible and beneficial uses and users of space capabilities.

The data processing and analyses dimensions are discussed below in Section V,D. The alternate futures dimension is discussed in Section III and Appendix A. Figure V-2 is a heuristic diagram of these dimensions.

C. INITIAL CONSTRUCTION OF THE METHODOLOGY

The construction of the methodology involved utilizing the design requirements and guidelines discussed in the preceding section to construct appropriate functions, and to implement these functions into the methodology. In order to do this, these functions had to be characterized to a point where the practicality and germaneness of the methodology could be recognized, the basic purpose in Task 2. In cases where large quantities of data are to be analyzed--for example, as for the analysis of the data involving a potential user community--a data processing and a management information system must be defined (Task 3); and in order to effect the use of the management information system, an input data base must be developed (Task 4).

The data base for this study currently includes information describing: (1) user goals and priorities, (2) NASA capabilities, and (3) constraints (economic and budgetary, legal, political, social, technical, and temporal). These are absolutely essential for meaningful operation of the methodology and form the minimum required input data set. Other input may prove desirable as NASA gains experience in exercising the system.

In using the design requirements for the construction of the methodology, an evolutionary process of organizing the required functions was used to permit the inclusion of changes and modifications to the methodology, as required, as shortcomings were recognized in its construction.

Figure V-3 is a flow diagram which is an evolutionary form of the basic methodology shown in Fig. V-1. In its evolved form, Fig. V-3

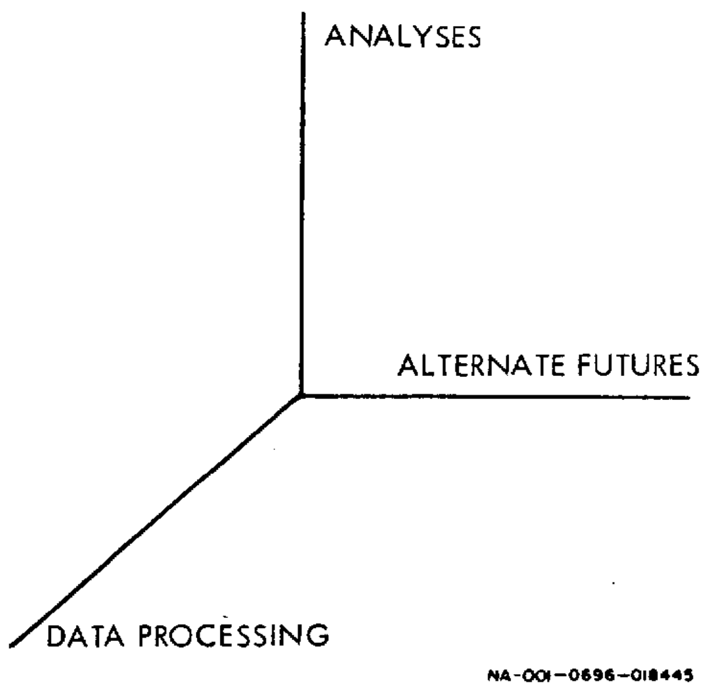

FIG. V-2 FUNDAMENTAL DIMENSIONS OF THE METHODOLOGY

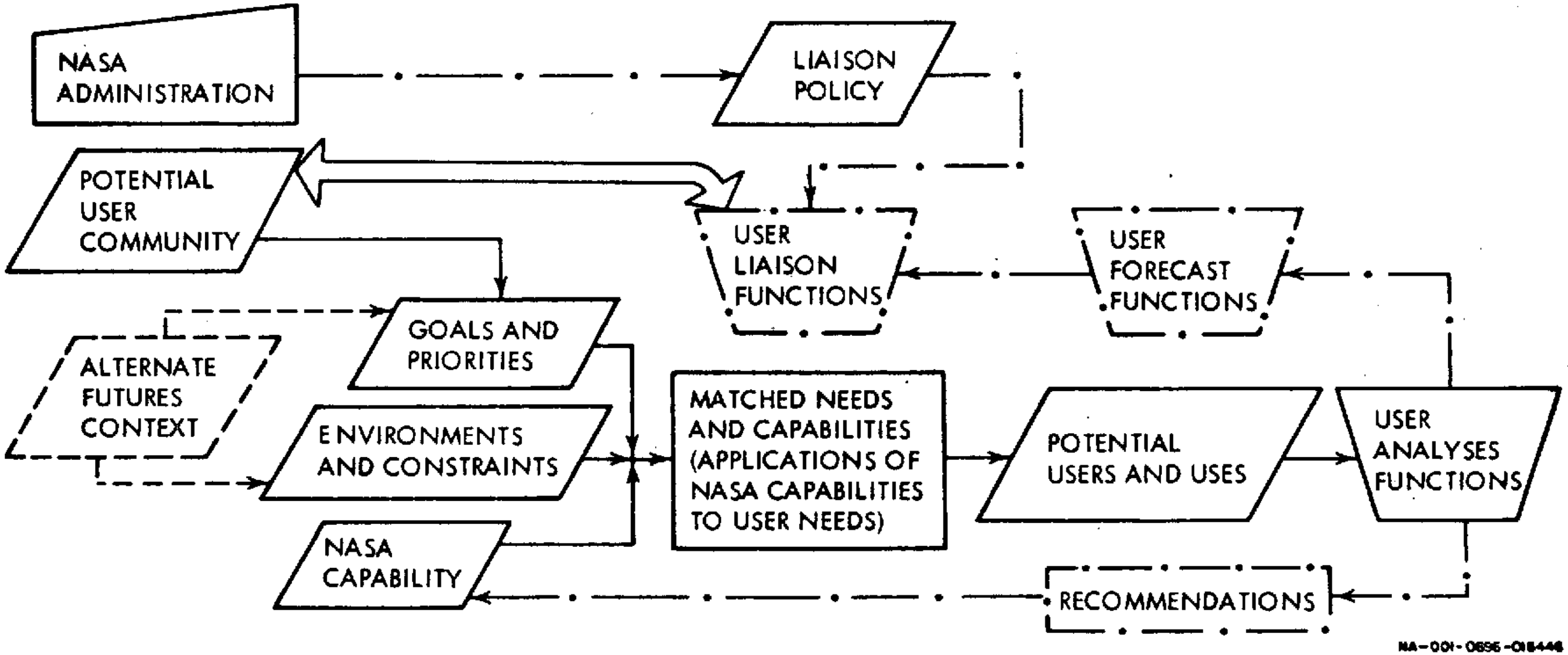

FIG. V-3 THREE DIMENSIONAL ASPECTS OF OVERALL METHODOLOGY

represents the three dimensional features of the methodology in its simplest conceptual form. The solid lines represent the data processing dimension, the dot-dashed lines represent the analyses or data use dimension, and the dashed lines represent the alternate futures dimension.

1. Management Information System

The amount of useful information available on potential users and uses of space capabilities is so voluminous that it is not considered practical for an individual user analyst to analyze this information without the use of an appropriate management information system. The most useful system envisioned at this time is essentially a cataloging system which will provide a user analyst with only the data he needs. Although full development of the management information system is appropriately a Phase II task and, therefore, beyond the scope of this effort, basic requirements for its overall structure have been identified. These requirements include, but are not limited to, the following components;

(1) A file-structured data base with an effective Data Base Management System (DBMS). The data base can, in turn, be defined as an integrated source of data which lists a community of users and is controlled by a DBMS.

(2) The data base will be made up of files containing key information including:

  (a) Government users listed by departments, agencies, and special offices

  (b) User characteristics with emphasis on specific goals, priorities, and technical capabilities and requirements

  (c) NASA capabilities listed by (1) discipline/technology functions, (2) services/consulting functions, and (3) a technological data bank function to correlate previous mission data archives.

The purpose of the management information system is to store and process "potential" user information data and NASA capabilities as outlined above. This management information system should not be confused with other information systems (for example, the Integrated Data and

Information System*) currently in use or being planned by NASA for "actual" missions, although they may be of considerable use to the user analyst.

The basic functions of the Management Information system discussed here are to: (1) catalog users and user characteristics, (2) list user requirements, (3) catalog NASA capabilities, (4) integrate the NASA and user data, and (5) facilitate matching of user needs to NASA capabilities.

The software and hardware requirements need not go beyond the application of programming talent and facilities available at all NASA centers, unless data transmission requirements become more severe than currently envisioned.

It is premature to specify the input and output formats in rigorous detail at this time. This specification should be a task, or subtask, of Phase II.

2. Input Data Base

A key component of the management information system discussed above is the input data base. This data base consists of all data identifying user goals and priorities, NASA capabilities, and environmental data and constraints.

While it is a Phase II activity to detail this Input Data Base, Fig. V-4 shows an example of user characteristics in terms of their goals and needs.** Figure V-5 shows an example functions/applications matrix of NASA's capabilities and the potential application of these capabilities to problems involved in various disciplines. It appears from studies conducted to date that it will be convenient to divide the disciplines into no fewer than seven categories: earth resources, earth phenomena, earth civilization, physical sciences, biological or life sciences, new

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* This is essentially a global data handling and data processing system designed to process data from space to meet advanced requirements of actual users like experimenters, scientists, engineers, etc.

** In its final and usable form the user characteristics should include goals and needs in a prioritized list.

DEPARTMENT, AGENCY COMMISSION, OR SPECIAL OFFICE	CHARACTERISTICS GOALS, NEEDS AND PRIORITIES
DEPARTMENT OF AGRICULTURE	CONTROL CROP DISEASE CONTROL CROP PRODUCTION CONTROL CROP EXPORT DEVELOP NEW INSECTICIDES
DEPARTMENT OF COMMERCE	FORECASE BUSINESS TRENDS MONITOR INTERSTATE COMMERCE MONITOR UNEMPLOYMENT
DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE	IMPROVE EDUCATIONAL STANDARDS RESEARCH NEW PHARMACEUTICALS MONITOR UNEMPLOYMENT
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT	URBAN RENEWAL AID DISASTER VICTIMS LAND USE PLANNING
DEPARTMENT OF THE INTERIOR	DISCOVER NEW ENERGY SOURCES DEVELOP NEW RESOURCES MONITOR USE OF EXISTING RESOURCES
ATOMIC ENERGY COMMISSION	DEVELOP NUCLEAR WEAPONS DEVELOP NUCLEAR ENERGY SOURCES CONTROL RADIOACTIVE WASTES
FEDERAL ENERGY OFFICE	CRUDE OIL MANAGEMENT DISCOVERY OF NEW ENERGY SOURCES GASOLINE DISTRIBUTION MANAGEMENT RADIOACTIVE WASTE DISPOSAL
ENVIRONMENTAL PROTECTION AGENCY	MONITOR AIR POLLUTION ENFORCE AIR POLLUTION STANDARDS ENFORCE EMISSION STANDARDS
BUREAU OF NARCOTICS AND DANGEROUS DRUGS	ENFORCE DRUG CONTROL LAWS CONTROL FLOW AND USE OF ABUSIVE DRUGS LOCATE DRUG PRODUCERS
U.S. WEATHER SERVICE	CLIMATOLOGY WEATHER FORECASTING

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FIG. V-4 EXAMPLE OF USER CHARACTERISTICS IN THE INPUT DATA BASE

FUNCTIONAL CAPABILITY IN SPACE / DISCIPLINES	EARTH RESOURCES: LIMNOLOGY, FORESTRY, FOSSIL FUELS	EARTH PHENOMENA: CLIMATOLOGY	EARTH CIVILIZATION: SOCIAL, POLITICAL, EDUCATION, DEFENSE, ENERGY, LAW ENFORCEMENT	PHYSICAL SCIENCES: ASTRONOMY, PHYSICS	BIOLOGICAL SCIENCES: BIOLOGY, BOTANY, MEDICINE	NEW TECHNOLOGY: METALLURGY	SUPPORTING SPACE TECHNOLOGY: TUG
• MONITOR	O	O	O	O			
• COMMUNICATIONS/ NAVIGATION			O				O
• EXPERIMENT				O	O	O	O
• MANUFACTURE	O		O			O	
• SATELLITE TENDING & MAINTAINENCE							O
• SATELLITE CAPTURE							O
• SPACE TRANSPORT - BOOST LOW ORBIT POLAR GEO SYNC. - ORBIT TRANSFER - LUNAR ORBIT - INTERPLANETARY			O				O

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FIG. V-5 FUNCTIONS/APPLICATIONS MATRIX

technology, and supporting space technology. The advantages of forming such categories in the functions/applications matrix is that these categories of disciplines lend themselves to convenient comparison with required disciplines in the user community. It is believed that the functions/applications matrix is an improvement over previous attempts to relate user disciplines to NASA's capabilities, since it explicitly sorts out NASA's functional capabilities from the associated disciplines.* Figure V-6 is a more complete functions/application matrix developed for only three discipline categories - earth resources, earth phenomena, and earth civilization. It should also be noted that the functional capabilities in Fig. V-6 include technical services on Earth as well as space services. Earth-based services may be of equal or even greater benefit than space services to some potential users.

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* NASA's functional capabilities are frequently listed with various disciplines thereby creating ambiguities and confusion.

NASA CAPABILITIES \ DISCIPLINES	SOILS	CROPS	RANGES	FORESTS	WILD ANIMALS	FARM ANIMALS	WILD VEGETATION	MARINE LIFE	PREDICTIVE & EVALUATIVE HYDROLOGY	LIMNOLOGY	OCEANOGRAPHY	MINERAL RESOURCES	ENERGY RESOURCES	MARINE ENVIRONMENT	OCEAN DYNAMICS	WEATHER STRUCTURES	CLOUD DYNAMICS	ATMOSPHERE TEMPERATURE PROFILES	EARTHQUAKE MECHANISMS	VOLCANIC ACTIVITY	POLAR CAP DYNAMICS	SUPPORT OF MET. SAT. SYSTEM	CLIMATOLOGY	GEOGRAPHY	SEVERE STORM WARNING SYSTEMS	LONG-TERM WEATHER FORECASTING	ATMOSPHERIC ENVIRONMENT	AIR POLLUTION	WATER POLLUTION	SOIL POLLUTION	DEMOGRAPHY	ENVIRONMENTAL DEGRADATION	LAND BANK MONITORING	AIR TRAFFIC MONITORING	LAND TRAFFIC MONITORING	WATER TRAFFIC MONITORING	INDUSTRIAL GROWTH	WATER TABLE MANAGEMENT	DATA INTERPRETATION TECHNIQUES	BROADCAST SYSTEMS	INFORMATION NETWORKS	DATA COLLECTION SYSTEMS	TRACKING & RELAY SATELLITE SYSTEMS	COMMERCIAL NETWORK SYSTEMS	DOD NETWORK SYSTEMS	INTERNATIONAL CARRIER SYSTEMS	EMERGENCY/DISASTER WARNING	BIOMEDICAL COMMUNICATIONS SYSTEM	SATELLITE MAIL SYSTEM	MATERIALS MANUFACTURING	ZERO-G PROCESSES	SPACE VACUUM PROCESSES	SPACE POWER PLANTS	NUCLEAR WASTE DISPOSAL	MULTIPLE RESOURCES SOURCES
FUNCTIONAL CAPABILITIES IN SPACE	EARTH RESOURCES													EARTH PHENOMENA													CIVILIZATION PHENOMENA																													
MONITORING FUNCTIONS																																																							
COMMUNICATIONS																																																							
EXPERIMENTS IN SPACE																																																							
SATELLITE MAINTENANCE																																																							
SATELLITE RECOVERY																																																							
SPACE TRANSPORTATION																																																							
FUNCTIONAL CAPABILITIES ON EARTH																																																							
PAYLOAD DESIGN & CONSTRUCTION																																																							
INSTRUMENT DESIGN & CONSTRUCTION																																																							
DESIGN OF EXPERIMENTS																																																							
DESIGN OF MISSIONS																																																							
OVERALL SCIENTIFIC SERVICES																																																							
TECHNOLOGY APPLICATION SERVICES																																																							
TECHNICAL DATA REDUCTION, COLLECTION, AND HANDLING																																																							
EVALUATION & ANALYSIS OF RAW DATA																																																							
IN-DEPTH SYSTEM STUDIES																																																							

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FIG. V-6 APPLICATIONS

FOLDOUT FRAME 1

FOLDOUT FRAME 2

D. ADVANCED CONSTRUCTION OF THE METHODOLOGY

The next step in the evolution of the methodology was the development of the data processing and analyses dimensions commensurate with the basic features of the methodology in its final, but top level structure. Figure V-7 is a flow diagram showing this structure. The methodology in this form shows that the basic input required for the data processing dimension is composed of information on potential users* and NASA capabilities. The alternate futures context, however, is also part of the input. (This dimension is discussed in detail in Section III and Appendix A.) The remaining aspects of the data processing dimension are involved with the manipulation of the input data in the relevancy, benefit, and practicality filters. The results of these operations are then used by the user analysts in the analyses dimension. The user analysts will analyze the data further to determine the benefits and feasibility of NASA capabilities to:

(1) Determine direct STS use requirements for

    (a) Specific missions
    (b) Mission models

(2) Determine STS support requirements including

    (a) Payload design
    (b) Research and Development
    (c) Special studies
    (d) Air flights

(3) Determine needs for technology utilization involving

    (a) Developed technology
    (b) Data from previous missions
    (c) Use of integrated data and information system

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* Domestic government users in this study, although the methodology is sufficiently general in scope that other user communities could be treated with the same methodology.

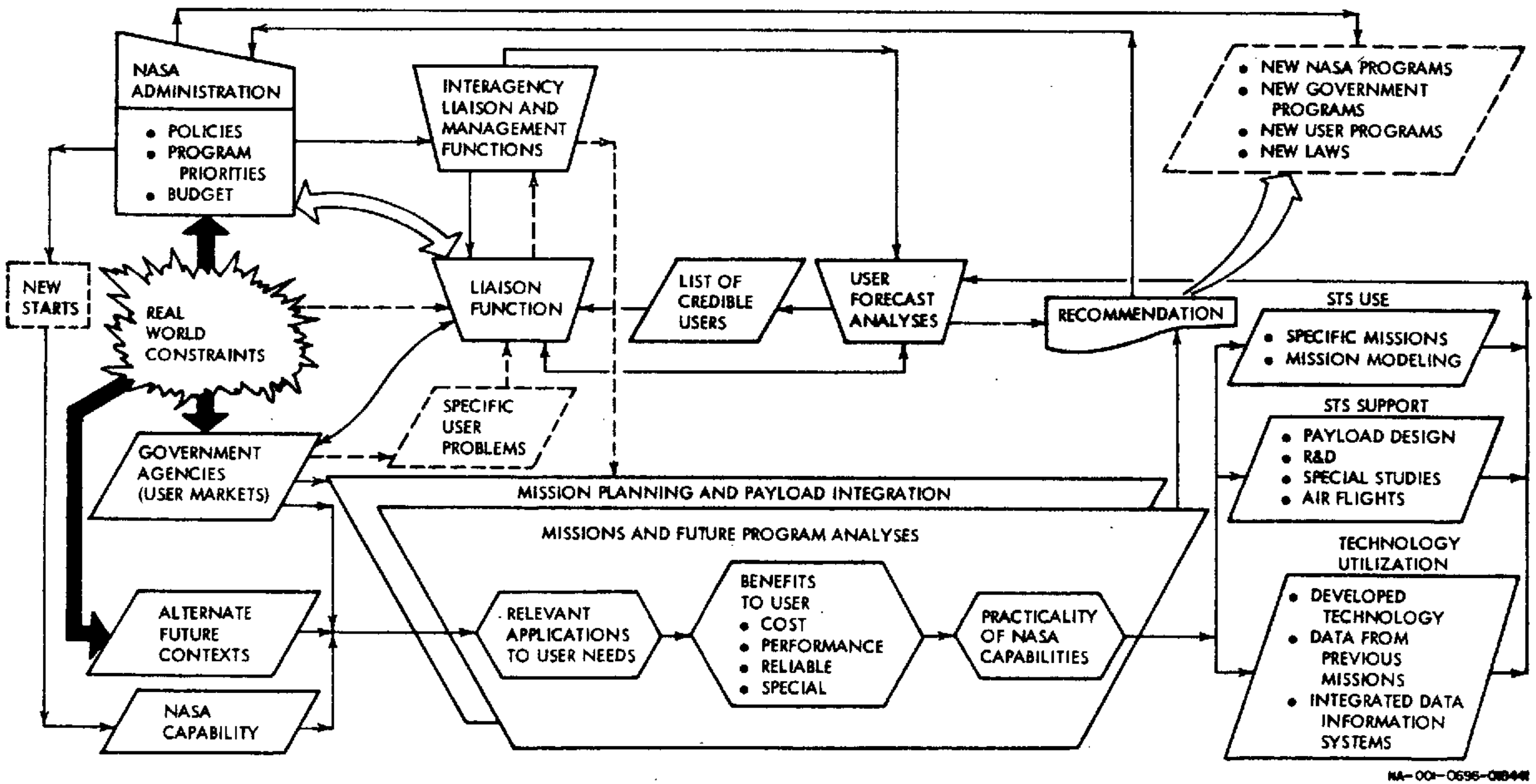

FIG. V-7 THE METHODOLOGY

(4) Conduct user forecasting analyses including

   (a) Futures opportunities analysis

   (b) Listing most likely users in specified time frames

   (c) Listing most likely users in forecasted budget picture

   (d) Listing special problems affecting specific likely users

   (e) Listing possible but less likely users and their special problems

(5) Prepare policies and procedures for conducting appropriate liaison activities between potential users and NASA

(6) Conduct liaison activities with potential users until specific uses are identified

(7) Conduct mission and payload planning monitoring activities after specific uses have been identified, in order to provide an effective, long-term, continuing interface with users of NASA capabilities.

This information can then be used with a high degree of credibility and low degree of risk for forecasting potential users, since it will be based on known benefits and relevancy to the potential users. A key feature of the methodology is its ability to provide potential user forecast data to the liaison specialists that contact potential users. These liaison specialists will be able to provide potential users with appropriate information to show them the beneficial options available to them by using NASA's capabilities. (This liaison activity is discussed in greater detail in Section IV of this report.)

The paragraphs that follow further expand the concepts given above.

1. <u>The Data Processing Dimension</u>

Using the inputs discussed above, the primary function of the data processing dimension of the overall methodology is to provide information to the user analysts who will channel appropriate data through the system to potential users. This will enable the user analysts to readily filter out potential non-users from credible potential users in order to

maximize credible and beneficial uses of the STS and other NASA capabilities. A convenient way to visualize the data processing dimension is to recognize that the primary concern is with a "set of operations acting on the input data." These input data are discussed in Section C, 2 above, and include the input data base of the management information system, NASA's capabilities, and changing environmental factors from the alternate futures. The operations acting on these input data include:

(1) Data Collection
(2) Data Sorting
(3) Data Matching
(4) Data Filtering
(5) Data Modeling
(6) Data Dispensing.

Moreover, the data processing dimension can be defined in terms of three sub-dimensions: operations, input, and time. The time sub-dimension takes into account that the goals, needs, and priorities of potential users change with time and with each different future. This is also true of NASA's capabilities. Heuristically, these three sub-dimensions can be represented as shown in Fig. V-8.

In this respect, one can regard the data processing dimension as a skeletal or perhaps restricted version of the methodology itself. Each of the data processing sub-dimensions is discussed below.

a. Data Collection

The data collection operation is the basic operation required by a user analyst to develop and maintain the input data base and management information system discussed in Sections C,1 and C,2. Figures V-4, V-5, and V-6, discussed previously, are examples of the kinds of data that must be collected. The data collection operation does not, however, end there. Catalogued data, specified for a given user, must be gathered from the management information system to be evaluated for relevancy of application to NASA's capabilities. Other required data collection operations include a continuous updating of NASA's capabilities and the

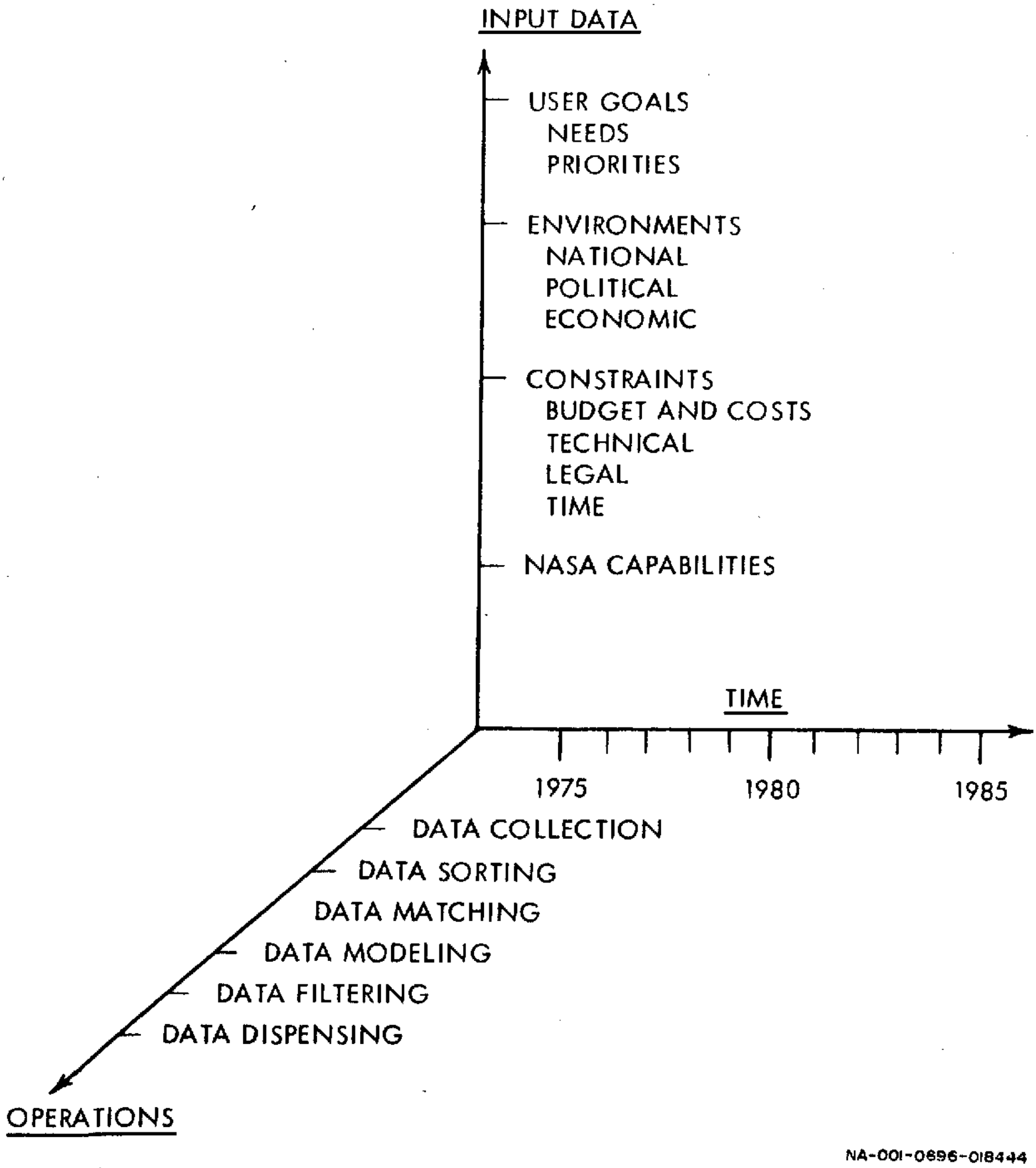

FIG. V-8 SUBDIMENSIONS OF DATA PROCESSING DIMENSION

environmental data describing the condition in which NASA's capabilities will be utilized.

b. Data Sorting

The data sorting process classifies and catalogues selected input data that will be subjected to critical analysis by a user analyst specialist. Key sorting operations include those which will yield:

(1) Data describing approved government programs and functions

(2) Prioritized user/need list

(3) Data describing required and possible government programs and functions currently not approved.

Other sorting and classifying operations are involved in the more specialized filtering operations discussed below.

c. Data Matching

The data matching operation primarily involves matching NASA's capabilities with the prioritized user/need list and is used in conjunction with the relevancy filter operation discussed below. Other matching operations, such as matching cost data, performance data, and reliability of alternate user solutions and NASA's solutions to determine cost, performance and reliability benefits, will be involved in applying the benefits filter discussed below.

d. Data Filtering Operations

The most complex operations in the methodology are the data filtering operations. As mentioned above, the primary function of the data processing dimension is to provide information to the user analysts who will channel the data through the system to obtain usable outputs. The filtering operations enable the user analysts to properly filter out probable non-users from the possible users in order to maximize credible and beneficial uses of space and other NASA capabilities.

The identification of credible and beneficial uses of space and other NASA capabilities can be maximized by applying three filters

in the data processing dimension: (1) a relevancy filter to identify relevant applications of NASA capabilities to user needs, (2) a benefits filter to identify beneficial uses of NASA capabilities to the user, and (3) a practicality filter to assure NASA solutions are possible both conceptually and practically.

The filter process for identifying potential uses and users of space was selected to manage the enormous quantities of data that would be, or could be, generated by the overall methodology.

The management and refinement of such data will be necessary to efficiently and effectively limit an exhaustive list of potential uses and users of space to highly probable candidates only. The disadvantage, however, is that some potential uses and users may not become visible by using the methodology. This disadvantage may be circumvented by establishing a special function which reevaluates marginal uses of space and identifies the more subtle and innovative uses of space, which may not be identified directly by the methodology. The techniques appropriate for this special function are expected to be highly subjective and inherent in the skills of the individuals involved in the filtering analysis; therefore, they will not be discussed in this report.

Each of the three filters used in the data flow dimension is discussed in greater detail below.

1) The Relevancy Filter

The basic purpose of the relevancy filter is to identify relevant applications of NASA capabilities to user needs. Figure V-9 is a flow diagram describing this filter. As shown in the figure, the key input elements in this filter are the user community and NASA capabilities data and the outputs from the alternate futures dimension.

This input data must be properly formatted, sorted, and classified before it can be used in the management information system. Properly prepared input data (see Section V,C) to the management information system will yield:

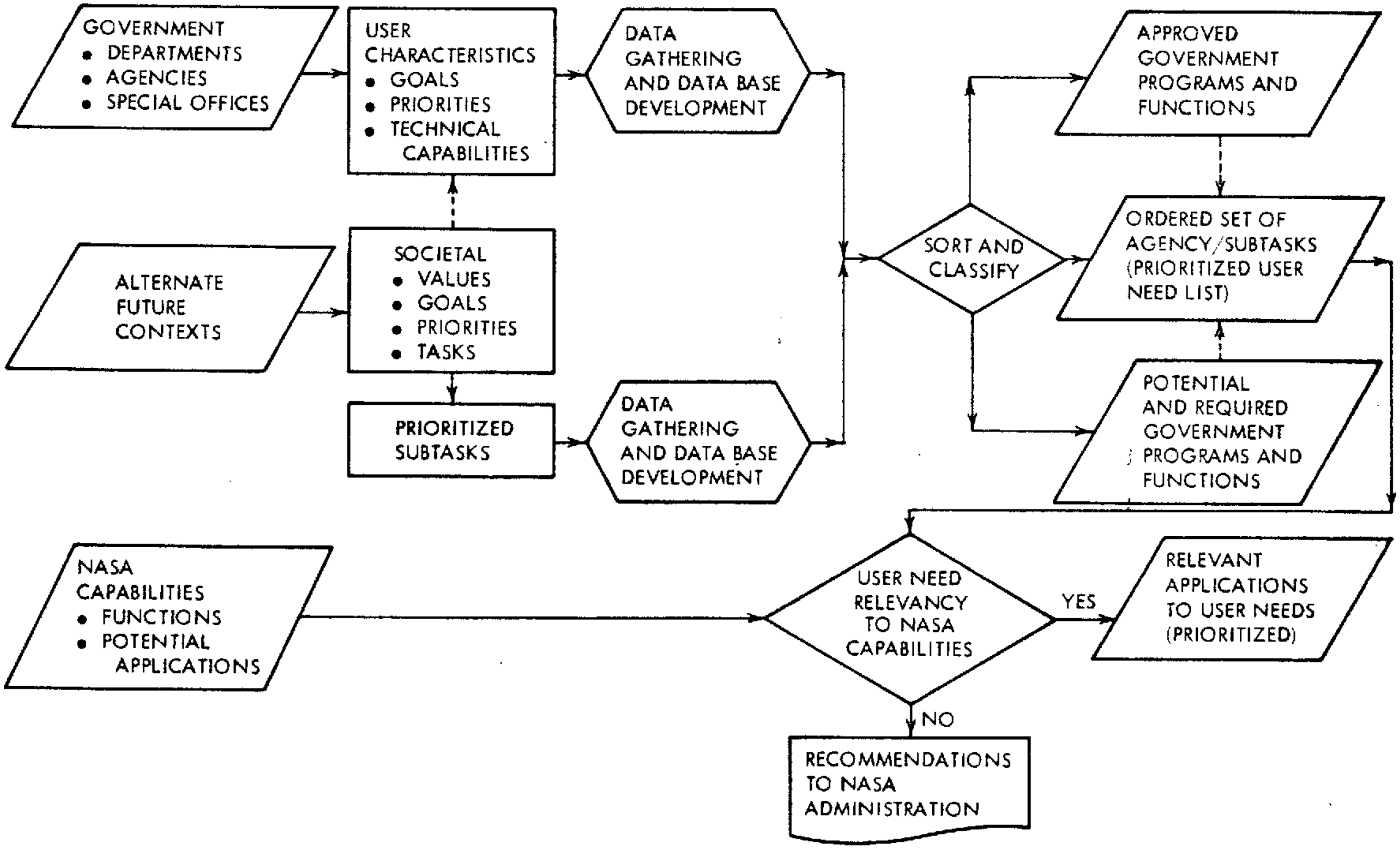

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FIG. V-9 APPLICATIONS RELEVANCY FILTER

(1) A prioritized user/need list

(2) A current list of approved user programs and functions designed to satisfy the user's needs

(3) Potential and required user programs not currently approved and perhaps not even planned.

The user analyst can then compare the approved and potential programs with the user need list to provide an initial assessment of user problems and how those problems are being solved. An example user/need list is shown in Fig. V-10.* A prioritized user need list is constructed by gathering common goals and needs such as those shown in Fig. V-4, and by using the sorted opportunities and restraints data from the alternate futures dimension discussed in Section III.

The prioritized user/need list can then be compared with NASA's capabilities as shown in Figs. V-5 and V-6 to determine which of NASA's capabilities are relevant to solving the most pressing of a particular potential user's problems.

At this point, the basic relevancy filter will be exercised to determine relevant applications of NASA capabilities to user needs. These relevant applications will then be further processed in the benefits filter discussed below. In cases where NASA's capabilities do not appear relevant to the user's needs, a reevaluation should be conducted by highly skilled personnel to assure that NASA's capability was indeed inappropriate for that particular user need. For example, a new NASA program, not currently planned, may be identified that may be of considerable benefit to the potential user and enhance NASA's capabilities.

A unique feature of the relevancy filter is that potential applications of space disciplines to satisfy user needs can be examined

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* The user need list given in Fig. V-10 does not fully prioritize the list of needs. The consideration of futures data and other factors necessary to provide such a prioritization was beyond the scope of this study. This task is appropriately left for a Phase II activity.

FOLDOUT FRAME 1

FOLDOUT FRAME 2

DOMESTIC GOVERNMENT ELEMENTS

GOALS AND NEEDS	DEPARTMENTS										AGENCIES			COMMISIONS				SPECIAL OFFICES			
	AGRICULTURE	COMMERCE	HEALTH, EDUCATION, AND WELFARE	HOUSING AND URBAN DEVELOPMENT	INTERIOR	JUSTICE	LABOR	STATE	TRANSPORTATION	TREASURY	ECONOMIC STABILIZATION	ENVIRONMENTAL PROTECTION	VETERANS	ATOMIC ENERGY	FEDERAL POWER	FEDERAL TRADE	INTERSTATE COMMERCE	BUREAU OF NARCOTICS AND DANGEROUS DRUGS	FEDERAL ENERGY	U.S. GEOLOGICAL SERVICE	U.S. WEATHER SERVICE
REDUCE UNEMPLOYMENT		X	X			X	(X)			X	X		X								
CONTROL INFLATION	X	X	X	X			X	X		(X)	(X)		X								
CONTROL ECONOMIC STABILITY	X	X	X				X	X		(X)	(X)		X			X					
MANAGE GASOLINE DISTRIBUTION	X	X	X		X		X		X	X	X	(X)			X		X				
MANAGE CRUDE OIL USE		X			X		X	X			X	(X)			X					X	
ENFORCE AND MANAGE ENVIRONMENTAL STANDARDS	X	X	X				X		X	X		(X)		X							
MONITOR AIR, WATER, AND SOIL POLLUTION	X	X	X	X			X	X	X			(X)		X							
IMPROVE HEALTH CARE			(X)										X								
REDUCE HEART DISEASE			(X)										X								
IMPROVE EDUCATIONAL STANDARDS			(X)	X		X	X						X								
RENEW URBAN COMMUNITIES		X	X	(X)			X		X	X											
DISCOVER NEW ENERGY SOURCES					X							X		X					(X)	X	
DEVELOP NEW ENERGY SOURCES	X	X			X		X					X		X					(X)		
DEVELOP NUCLEAR ENERGY SOURCES		X	X		X			X				X		(X)					X		
CONTROL RADIOACTIVE WASTES	X		X		X			X				(X)		(X)					X		
DISCOVER NEW WATER AND MINERAL SOURCES					(X)		X	X				X								(X)	
CONTROL CROP DISEASES	(X)	X								X		X									
CONTROL CROP PRODUCTION	(X)	X								X	X										
CONTROL CROP EXPORTS	(X)	X						X		X	X										
DEVELOP NEW INSECTICIDES	(X)	X	X							X		X									
DEVELOP LOW COST TRANSPORTATION SYSTEMS		X	X	X			X		(X)			X	X			X					
DEVELOP RAPID TRANSIT TRANSPORTATION SYSTEM		X					X		(X)			X	X								
MONITOR TRAFFIC PATTERNS		X		X					(X)			X				X					
FORECAST BUSINESS TRENDS	X	(X)					X			X	X		X								
MONITOR INTERSTATE COMMERCE		(X)					X		X	X	X						(X)				
RESEARCH NEW PHARMACUETICALS			(X)									X									
RESEARCH NEW MATERIALS		X									X	X									
MANUFACTURE NEW MATERIALS		X									X	X									
CONTROL FLOW AND USE OF DRUGS						X		X										(X)			
LOCATE ILLEGAL DRUG PRODUCERS						X		X										(X)			
MONITOR DRUG PRODUCING PLANTS						X		X										(X)			
PLAN FUTURE USES OF LAND	X	X		X	X					X	X	X			X						

(X) PRIME CONCERNS

X SECONDARY OR UNRANKED CONCERNS

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FIG. V-10 USER NEED LIST

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immediately in the context of alternative futures; in this respect, the relevancy filter includes the alternate future dimension. We believe that this provides an important advantage over other methods in that the early filtering of applications relevant to user needs in the context of changing environments tends to reduce the number of high-risk programs, thus reducing costs by eliminating analyses of programs having a low probability of being funded. This means that the first filter provides early information on potentially credible applications to user needs.

Figure V-11 is a simplified example of the use of the relevancy filter discussed above. Using the data files of government users and user characteristics, as discussed in Sections C,1 and C,2, data can be gathered and sorted appropriately to identify programs designed to satisfy user goals and needs. These data files also can be used to construct the user/need list. Sorted opportunities and restraints from the futures dimension data can then be used to construct probable user priorities for the prioritized user/need list. In the example shown in Fig. V-11, relevancy to NASA's monitoring and space transportation capabilities can be established for crude oil management, radioactive waste disposal, and monitoring drug-producing plants. For example, because NASA's monitoring capabilities can be used to locate new, and study existing, oil deposits, they are relevant to management of crude oil by the Federal Energy Office (FEO). Similarly, using the STS for transporting radioactive wastes from the earth to deep space is relevant to environmental constraints imposed on energy production, a problem of concern to FEO. Also, monitoring the growth of abusive drugs is relevant to the efforts of the BNDD in controlling the illegal distribution of drugs. Although this example does not explicitly utilize the opportunities and restraints from the futures dimension data, and examination of the information given in the diagram should reveal the applicability of the fully developed relevancy filter. In each of these example cases, however, the establishment of relevant applications to user needs does not by itself establish a clear benefit, nor does it establish any indication of its practicality. This point is discussed in detail below.

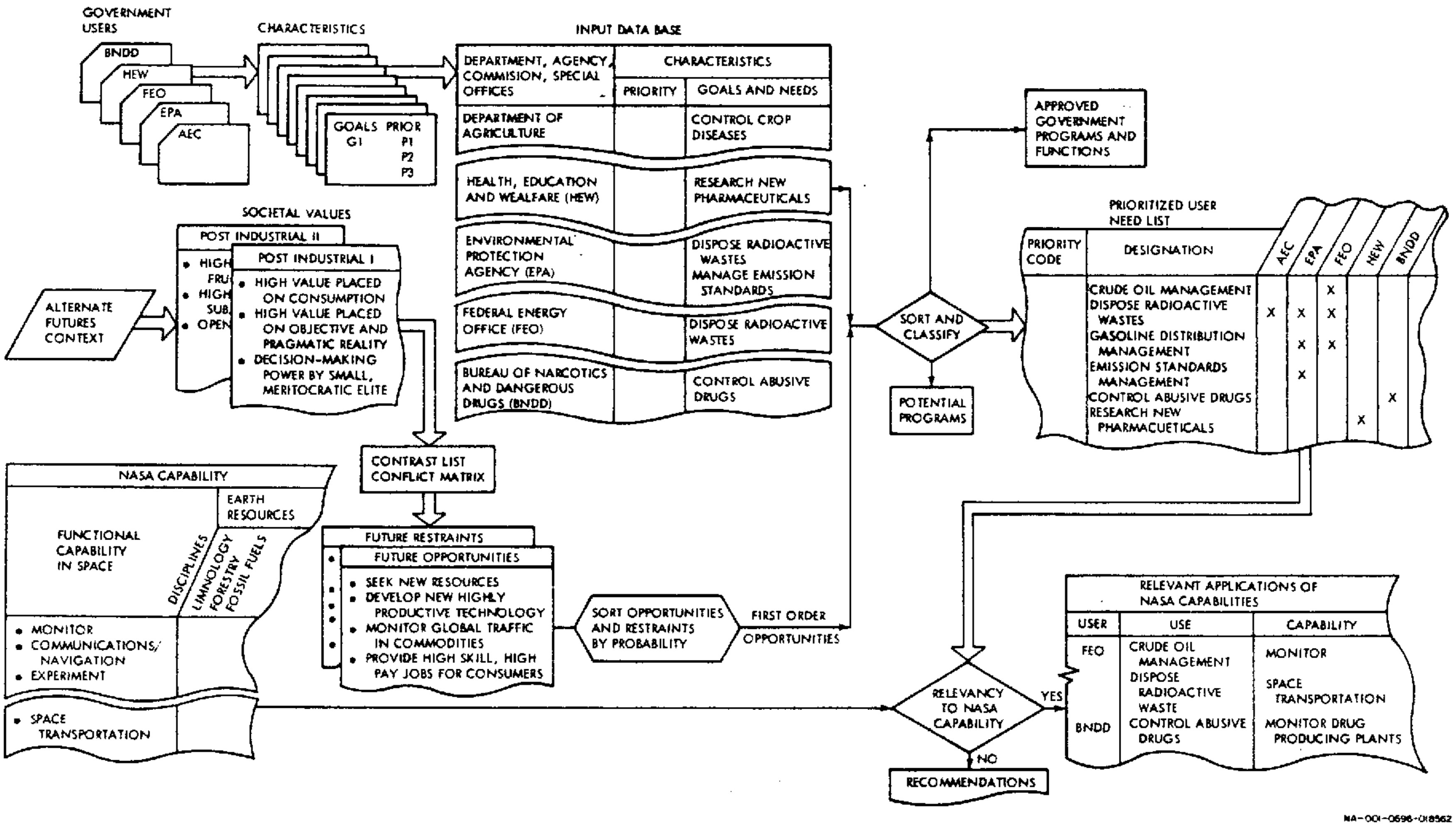

FIG. V-11 EXAMPLE USE OF RELEVANCY FILTER

2) The Benefits Filter

After establishing the relevant applications of NASA's capabilities to prioritized user needs, it is then necessary to determine if these relevant applications are beneficial to the user and practical in terms of technical, economic, and political feasibility. The benefits filter, shown in Fig. V-12, will determine an alternate set of solutions to potential user problems from solutions that the user is now using and the relevant applications to prioritized user needs. This alternate solution set can then be examined in greater detail in terms of environmental and other constraints to determine whether or not NASA's solution provides true benefits to the potential user. In cases where beneficial uses cannot be determined because of a lack of information, assessment and trade studies will have to be conducted until it can be determined whether NASA's solution is of greatest benefit. In order to properly determine the beneficial uses of NASA capabilities, it will be necessary to include a variety of environmental models, cost models, etc., to conduct trade-off studies of solutions in the alternate solution set. Cost, performance, and reliability benefits will be of particular interest to the potential user, although there are others of interest, such as safety and time benefits, that will be of particular importance in those situations where NASA's solutions are the only ones available.

The output of the benefits filter can be used to establish candidate mission objectives, although this output needs further examination to determine whether or not the NASA solution is conceptually and practically possible.

The use of the benefits filter may result in the conclusion that NASA offers the only solution(s) to a specific problem of a potential user. In this case, there is no need to conduct a trade-off study in the benefits filter. (Trade-off studies between alternate NASA solutions are conducted in the practicality filtering operation.) Trade-off studies will be required, however, in those cases where the set of NASA solutions is only a subset of the possible solutions.

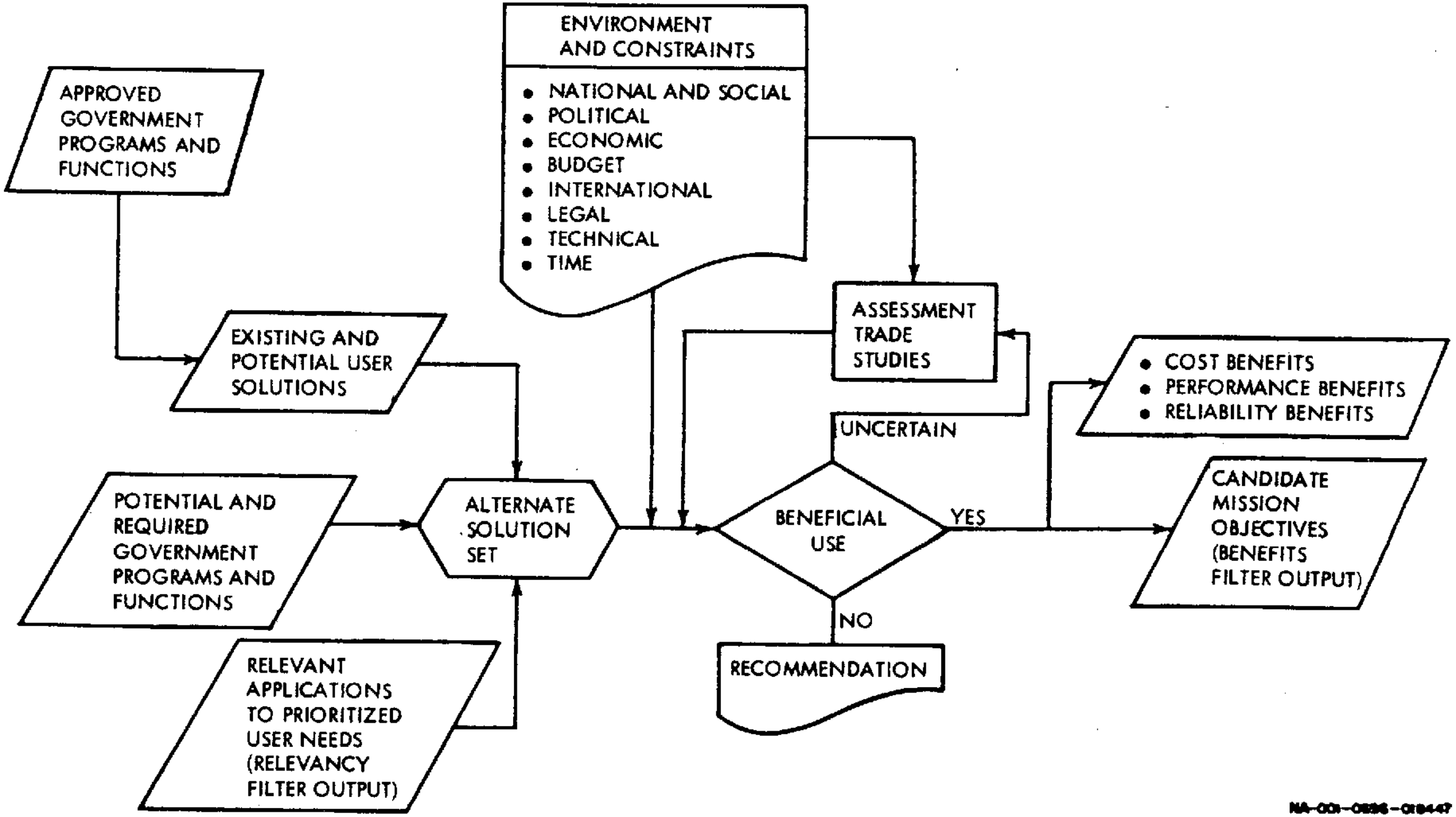

FIG. V-12 BENEFITS FILTER

The NASA solution set to be considered in the benefits filter consists of two types of solutions: those which are capable of being the primary tool for the solution of the problem at hand; and those which would fill a supporting role in the overall program of the potential user to solve his problem. It is important that both types of potential uses of NASA capabilities be included in the analysis.

In continuing the examples shown in Fig. V-11, consider the possibility of using the STS to dispose of radioactive waste materials. If the use of the STS is applicable to disposing of radioactive wastes, the problem is to determine whether or not it is a primary benefit to the FEO, EPA, or AEC. We know, for example, that current methods of safely disposing of radioactive wastes consist of dropping these wastes into a deep hole in the ground according to prescribed standards. Cost, performance, and reliability studies would be needed to determine the true benefits of uses the STS for this purpose.* Although using the STS may be more costly, disposal of this material in this manner may have performance and reliability benefits. On the other hand, safety concerns for catastrophic launch failures of the STS carrying radioactive materials may reduce the value of these benefits because of uncertainties in the overall environmental and safety benefits. If such uncertainties occur, detailed trade-off studies should be conducted to assure the potential user of the true benefits of using the STS for radioactive waste disposal.

Additionally, consider the use of the STS to monitor drug-producing plants. As discussed in the example use of the relevancy filter, monitoring drug-producing plants is a NASA capability relevant to controlling illegal distribution of drugs. If monitoring drug-producing plants is less expensive than the use of a large number of undercover

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* At the time this example was constructed, the authors were not aware of NASA activities addressing this same application. It was decided to retain this example in the report, however, in order to provide NASA an opportunity to assess the validity and completeness of the methodology through a comparison of the critical points identified in the example usage of the methodology with those identified by a different approach.

agents to locate such plants, then there is a cost benefit to BNDD. If monitoring drug-producing plants is more effective or efficient than current undercover activities, or if monitoring complements the current activity, then there are performance and possible reliability benefits.

3) The Practicality Filter

After determining that the application of a particular NASA capability is both relevant and beneficial to a potential user, it must be determined that it is both practically and conceptually possible.

The practicality of using NASA's capabilities to solve a potential user's problems refocuses the issues of cost, time, and usability. For example, the benefits filter may have shown that NASA's capabilities are cost-competitive or even cost-optimum in solving a user's problem; but, since such cost analysis is based on cost models, it is possible that inclusion of hidden costs and other factors may make the entire effort to costly and, therefore, economically infeasible.* In addition, although time constraints will have been considered to some extent in the benefits filter, the response time of NASA to provide a solution to a potential user must be examined in detail in the practicality filter. Finally, the usability of the information NASA can provide a potential user must carefully be considered in determining the practical benefits of using NASA's capabilities. For example, if NASA's capabilities are both relevant and beneficial to BNDD, a usable form of data pertaining to drug-producing plants is required in order to render this application practical. It is doubtful if raw sensor data would be of any use to BNDD. The cost of reducing these data is, therefore, an impartant consideration.

An additional factor affecting the practicality of a specific use of NASA's capabilities is the determination of the conceptual feasibility of that use. Feasibility questions must be addressed

* Provisions have been made in the benefits filter to overlay cost constraints on the solution of the overall problem; but, rapidly changing environments cannot be easily modeled and should be considered in real and practical terms by the analyst specialists.

in terms of state-of-the-art hardware considerations, testing, and implementation considerations. NASA's capabilities are addressed at the subsystem level in this filter as opposed to the systems level used in the relevance filter.

In many cases, the practicality filtering process may be included in the benefits filtering process. It is possible, however, to encounter situations where a given application of NASA's capabilities to a user's problem may require much testing and special hardware development. It is also conceivable that the alternate solutions could have similar testing and development requirements. In these cases, a separate practicality filter exercise is needed. The benefits filter would be of primary importance in selecting the solutions to be considered in the practicality filter. NASA's Concept Verification Testing (CVT) program is an example of practicality filtering for the more involved programs, and is certainly an excellent approach to clarifying and establishing the practicality of not only a candidate concept to be flow in space, but also of using NASA's capabilities to solve a potential user's problems.

Figure V-13 couples the practicality filter with the output of the benefits filter to show that together they function as an analytic procedure in establishing low-risk and highly credible uses and users of the STS and other NASA capabilities.

In terms of the methodology considered in this study, the inputs to the practicality filter are the candidate mission objectives given as an output from the benefits filter. Using specific NASA projects, technology, hardware, and--in some cases--software, a project/mission matrix can then be developed to identify mission options for baseline projects. It is anticipated that such an exercise will also lead to mission options requiring new projects.* A mission value assessment can be made on the mission options to determine if NASA's

* This expected result follows from the fact that it is possible to find mission options for which no projects exist--planned or unplanned.

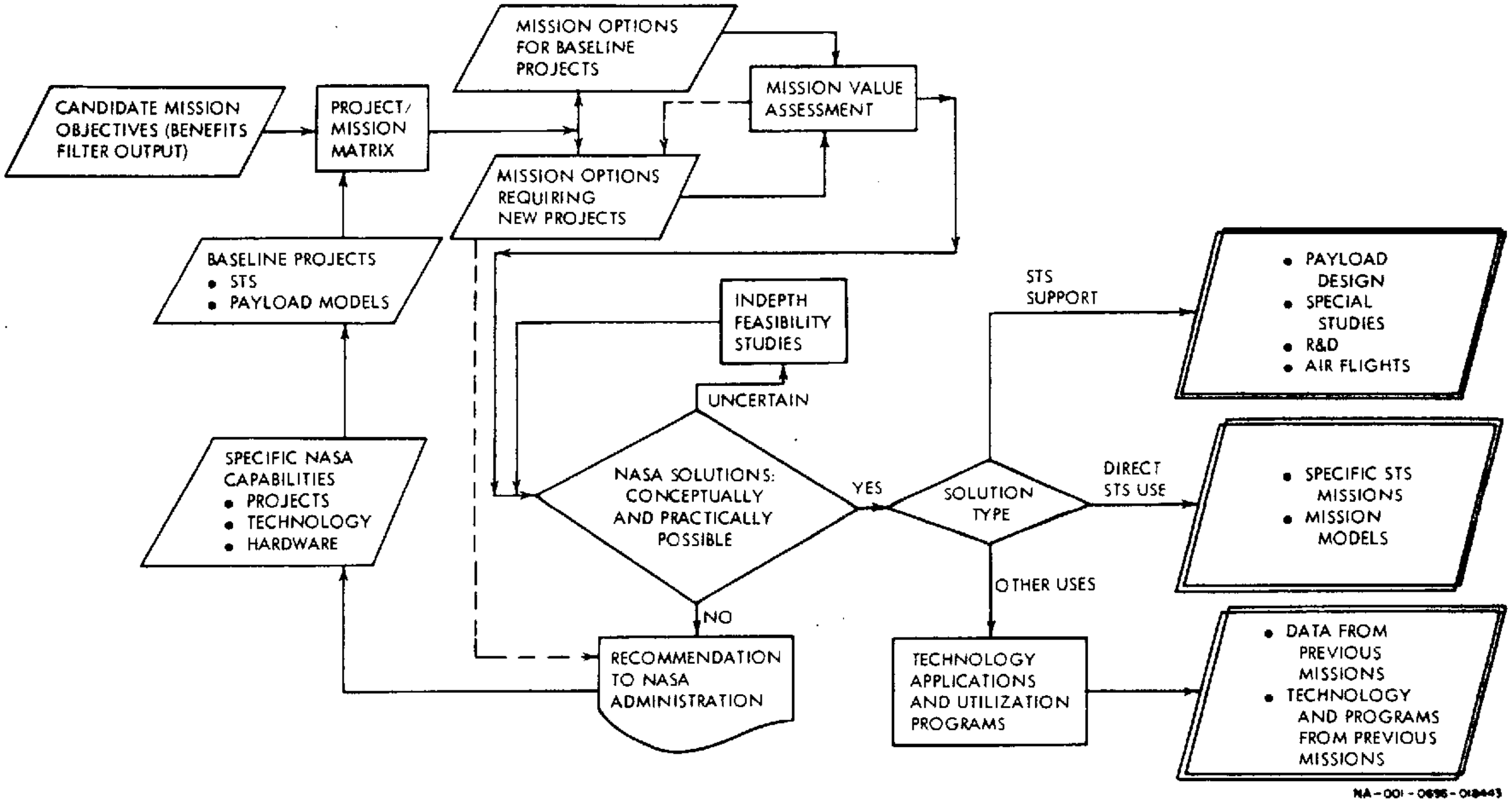

FIG. V-13 PRACTICALLY FILTER

solutions are consistent with technical realities, that is, conceptually and practically possible. There is little doubt that the mission value assessment may not always yield the required information. In such cases, additional indepth feasibility studies at the subsystem levels may be required.

If NASA's solutions are conceptually and practically possible, then the type of NASA solution can be readily determined. Such solution types include:

(1) Direct STS uses

  (a) Specific STS mission
  (b) Mission models

(2) STS support uses

  (a) Payload design and construction
  (b) Instrument design and construction
  (c) Design of experiments
  (d) Design of missions
  (e) Scientific services
  (f) Technical application services
  (g) Technical data reductions and collection
  (h) Data handling
  (i) Evaluation and analysis of raw data
  (j) In-depth systems analyses

(3) Other Uses

  (a) Data from previous missions
  (b) Technology transfer
  (c) Programs from previous missions.

It should be noted at this point that the order in which the benefits and practicality filtering processes are applied is not fixed. In some cases it may be more economical to use the practicality filter prior to using the benefits filter, or vice versa. Each case will have to be judged on an individual basis by the analysts conducting the analyses.

Figure V-14 shows a combined version of all three filters and the switching points which permit either the benefits filter or the practicality filter to be used directly after exercising the relevancy filter.*

The key feature of these filters is that they can be used to isolate the credible applications from the potential applications in current and near future national, international, social, political, and economic environments, and to establish cost and technical benefits to the credibles users. This is of fundamental importance, if future uses of space are to enjoy a high probability of being realized.

e. Data Modeling

In order to efficiently use the management information system, the data filters must provide user forecast analysts with usable information to identify probable users of the STS and other NASA capabilities. Many cases will require that certain data be modeled. In particular, many cost, performance, and reliability tradeoffs will be required to establish the beneficial uses of NASA's capabilities. Since this will involve a large number of variables, models of various types and degrees of detail must be generated. These models include:

(1) Cost models
(2) Performance models
(3) Reliability models.

It is beyond the scope and level of effort of this study to detail these models; it will require a special dedicated effort to develop and build them in Phase II.

Other models of vital importance in the overall methodology include:

(1) Potential user models
(2) Mission models
(3) General user information model.

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* It will be useful to re-examine Fig. V-7 to put the use of these filters in perspective with respect to the overall methodology.

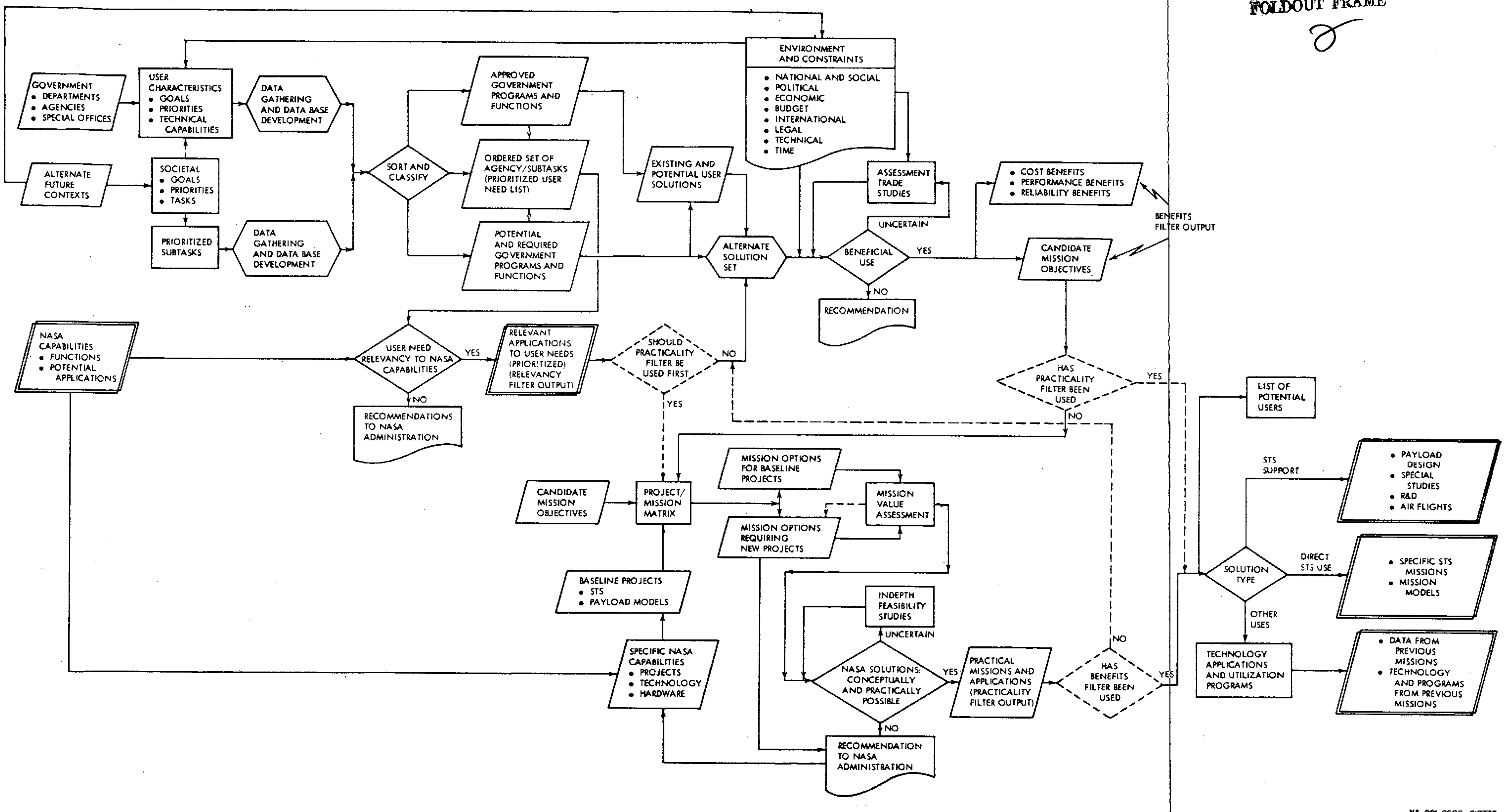

FIG. V-14 THE OVERALL FILTERING OPERATION IN THE DATA PROCESSING DIMENSION

The potential user models will be based on the main output of the data processing dimension shown in Fig. V-7. These models will be based on forecasting functions performed by the user forecast specialists.

The mission models are prime outputs of the data processing dimension to be used by user forecast specialists, mission planners, and other analysts to conduct and plan future missions.

Finally, due to the varied types of different potential users and the special requirement each may have, it is anticipated that special and general user information models will be required to aid in cross checking data to assure analysts that the maximum number of possible users of NASA's capabilities have been identified. The details of these models are very nebulous and may not be fully defined until Phase III. They are mentioned here, however, to assure that this easily overlooked and potentially troublesome point is provided for in the methodology.

f. Data Dispensing

This operation is primarily concerned with dispensing the collected, sorted, matched, filtered, and modeled data discussed above. Dispensing and delivering data to points in the system is too often a problem; however, it is not a difficult problem, if provided for in early planning. An appropriately designed analyses dimension of the methodology should handle this operation, particularly if the NASA/user interface is reflected in this dimension as outlined in Section IV.

2. The Analyses Dimension

A crucial requirement in the overall methodology is the analysis and use of the information produced in the data processing dimension. The function of the analyses or data use dimension is to identify who will use the data in the data flow dimension, and how the data will be used. Much of this identification has been made in the discussion of the data processing dimension. In lieu of identifying a specific organization chart and various program offices, the analyses dimension will be discussed in terms of the functional uses of processed data and

the identification of the required functional interfaces. Figure V-15, which is essentially an overlay of Fig. V-7, depicts the functional features of the methodology in the analyses dimension. The purposes of these analyses are to identify credible uses of NASA capabilities and to forecast likely users and uses of space activities in terms of real-world environments and constraints, and to ultimately provide liaison personnel with appropriate data to effectively and efficiently interface with potential users (see Section IV).

As shown in Fig. V-15, appropriate data on potential users, alternate futures, and NASA's capabilities are analyzed to determine potential future programs and determine credible uses of the STS and other NASA capabilities. This information is then passed on to a group of specialists, having in-depth knowledge of the users' requirements, and these specialists attempt to forecast the use of NASA's capabilities by considering the existing and projected environmental factors. These specialists also forecast future uses of space in terms of opportunities available to NASA as determined by the futures opportunity analysis. These forecasts are then used in liaison activities, which mainly consist of NASA/potential user contract at both the highest level of the department, agency, or commission and the technical levels when appropriate. These liaison activities are critical to the success of the overall methodology.

After establishing a use for NASA's capabilities, program development, mission planning, and payload integration activities are undertaken until the actual mission is initiated. At this time the implementation and application activities become important and are continued until the user has his required output. NASA administrators must set careful and appropriate policies, maintain acceptable budget levels, and assure proper performance during the overall effort.

The individual analyses, or data use, functions to be conducted are;

(1) Gathering user data and maintaining the input data base

(2) Constructing and maintaining the management information system

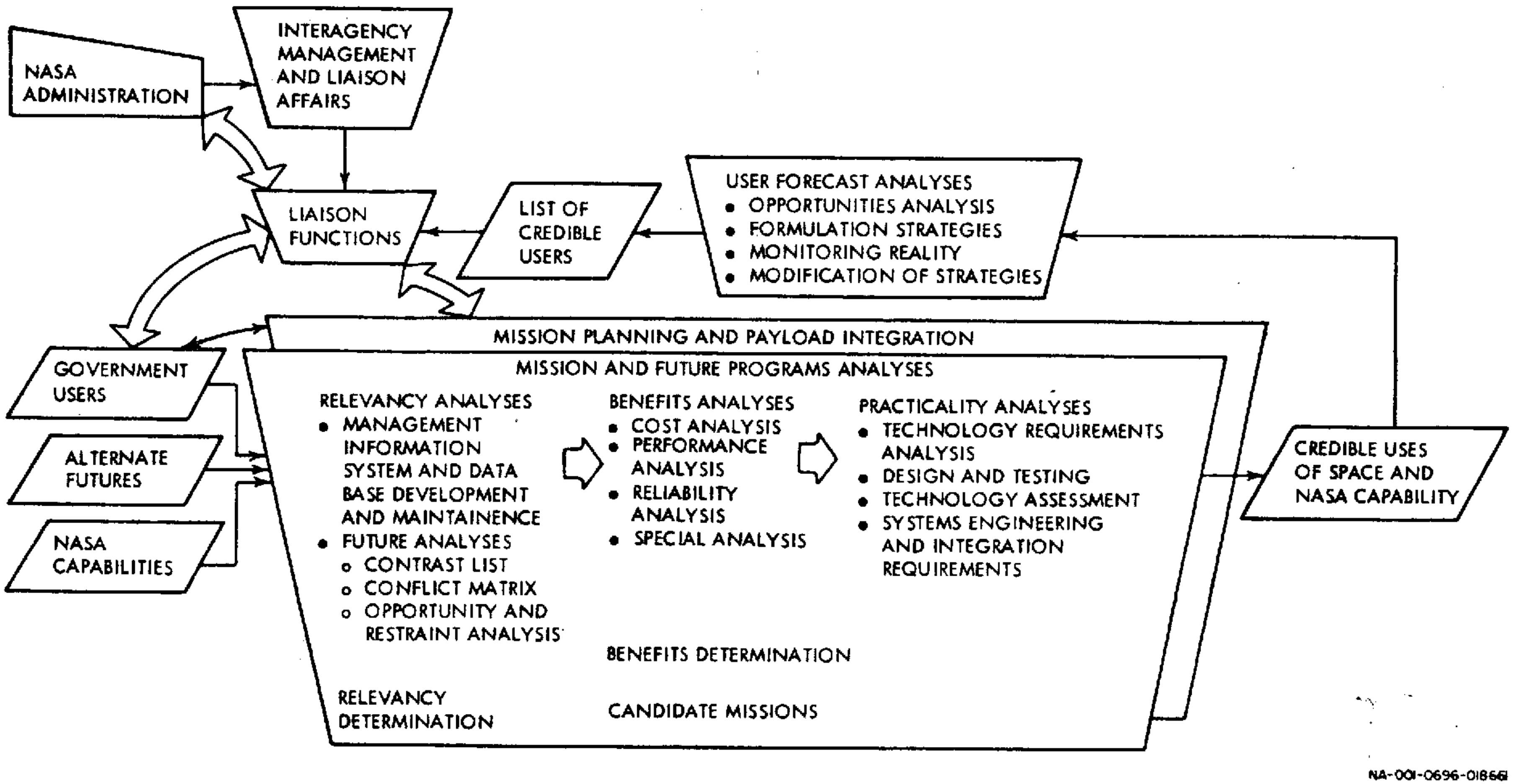

FIG. V-15 FUNCTIONAL INTERFACES IN THE ANALYSES DIMENSION

(3) Conducting futures analyses for the relevancy filter including:

  (a) Contract list development

  (b) Conflict matrix development

  (c) Opportunity and restraing analysis

  (d) Sorting opportunities and restraints by probability

(4) Using the data processing dimensions to determine relevant uses of NASA's capabilities in present and future environment

(5) Using the data processing dimensions to determine beneficial uses to potential users of NASA's capabilities showing:

  (a) Possible cost benefits

  (b) Performance benefits

  (c) Reliability benefits

  (d) Unique benefits

(6) Using the data processing dimensions to determine the practicalities and conceptual feasibilities of using NASA's capabilities for potential user's problems in terms of:

  (a) Technical realities (current and planned hardware programs)

  (b) New state-of-the-art requirements

  (c) Design and testing requirements

  (d) Systems engineering and integration requirements

(7) Developing usable output data for potential user requirements including:

  (a) Direct STS use requirements for:

    (i) Specific missions

    (ii) Mission models

  (b) STS support requirements including:

    (i) Payload design

    (ii) R&D

(iii) Special studies

(iv) Air flights

(c) Technology utilization

(i) Developed technology

(ii) Data from previous missions

(iii) Use of integrated data and information system

(8) Conducting user forecasting analysis including:

(i) Analysis of futures opportunities

(ii) Listing most likely users in specified time frames

(iii) Listing most likely users in forecasted budget picture

(iv) Listing special problems affecting specific likely users

(v) Listing possible, but less likely, users and their special problems

(vi) Formulation of strategies

(vii) Monitoring realities

(viii) Modification of strategies

(9) Preparing policies and procedures to conduct appropriate liaison activities between potential users and NASA

(10) Conducting liaison activities with potential users until specific uses are identified.

E. USER SCENARIOS AS EXAMPLE CASES FOR EXERCISING THE METHODOLOGY

This section extends the discussions of the example uses of the relevancy and benefits filters discussed in the previous section by giving examples of the operation of the entire methodology in terms of simplified user scenarios. It is anticipated that this user scenario method can be developed in greater detail from the fully constructed methodology.

The steps involved in the scenario approach are as follows:

(1) By using the user priorities list (Fig. V-10), list the users and the corresponding goal and need being addressed.

(2) Consider the effects of alternate futures environments on this goal.

(3) Determine the possible applications of NASA's capabilities to meeting this goal or need (Figs. V-5 and V-6).

(4) Determine the relevance of applying a specific capability (for example, monitoring, transportation, etc.).

(5) Determine possible benefits for applying NASA's capabilities.

(6) Determine the practicality of applying NASA's capabilities to meet the user's goal for the corresponding beneficial uses.

(7) Consider the program factors that would justify placing a mission in the mission model to meet the user's goal and need.

(8) List the output requirements of the user forecast analyst in predicting likely missions.

(9) Consider liaison functions in interfacing with a potential user.

Steps 1 through 4 are concerned with application of the relevancy filter; step 5 is the application of the benefits filter, and step 6 is the application of the practicality filter. The remaining steps involve various aspects of the analyses dimension of the methodology.

The example cases below illustrate the specific considerations which must be made as one attempts to use the methodology. The items in each item are numbered to correspond to the steps specified above.

1. User Scenario for Controlling Use of Abusive Drugs

(1) The BNDD is concerned with controlling abusive drugs.

(2) In the future, abusive drug use will either be restricted by law much as it is today, or it will be legalized.

(3) NASA has the capability to monitor drug-producing plants.

(a) If laws are maintained to control the use of abusive drugs, NASA's capabilities are relevant in aiding BNDD in controlling drug traffic.

(b) If the use of abusive drugs is legalized, NASA's capabilities are irrelevant.

(4) Assume the drug laws are maintained; then NASA's capabilities are relevant and the benefits of using NASA's capabilities must be determined.

(5) If monitoring drugs with spacecraft and/or aircraft with NASA support is:

(a) Cost-effective relative to the use of undercover agents and a ground-based intelligence network, then there is a cost benefit in using NASA's capabilities

(b) Capable of providing more information than is currently obtainable, then there is a performance benefit

(c) Capable of providing BNDD correct information more often from the use of NASA monitoring than other methods are capable of, then there is a reliability benefit.

(6) If the monitoring equipment can be built without greatly impacting or pushing the technology, the NASA capability is practical. If new exotic equipment is required to isolate a species of drug-producing plants, potential cost benefits may be lost and the entire concept of NASA use for this problem should be reevaluated.

(7) If the use of NASA capabilities are relevant, beneficial, and practical for locating drug-producing plants, then a program should be formulated to determine the cost and performance of actually using the NASA capability. The program should then be put into a candidate mission model.

(8) User forecasters should then examine the likelihood of using NASA's capabilities to monitor drug-producing plants.

(9) Liaison functions should be undertaken and contact should be made with BNDD. If BNDD agrees that NASA's capabilities satisfy their needs, then plans and agreements for future missions should be made.

2. User Scenario for Nuclear Waste Disposal*

(1) The FEO, EPA, and AEC are elements of the federal government having goals and needs relating to clean, safe, and economical disposal of radioactive waste materials.

(2) In the future, radioactive waste disposal will remain as an important requirement regardless of whether society becomes more conservation-oriented and frugal or remains consumption-oriented. Energy demands are not expected to decrease although the availability of cheap fossil energy is expected to decrease. Thus, nuclear and fast breeder reactors will be an important source of energy in the future.

(3) NASA's capabilities for the disposal of radioactive waste materials are of utility in the transport of these materials into space away from the earth. The STS may be able to do this more economically than previous transportation systems.

(4) If the FEO, EPA, and AEC develop plans for disposal of radioactive waste materials within specific environmental and safety standards, NASA capabilities are relevant.

(5) If transporting radioactive wastes to outer space is an improvement over current methods:

   (a) With respect to environmental standards, then this is an environmental benefit of prime concern to EPA

   (b) With respect to costs, then this is a cost benefit to AEC, FEO, and others

   (c) With respect to low probability of contaminating the earth, then this is a reliability benefit for all concerned

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* At the time this example was constructed, the authors were not aware of NASA activities addressing this same application. It was decided to retain this example in the report, however, in order to provide NASA an opportunity to assess the validity and completeness of the methodology through a comparison of the critical points identified in the example usage of the methodology with those identified by a different approach.

(d) With respect to quantities of radioactive wastes being disposed of, then this is a performance benefit to all concerned parties.

(6) If NASA's capabilities to transport radioactive wastes to space are relevant and beneficial to the users, and the STS can be economically used to conduct such a mission, then NASA's capabilities are practical.

(7) If NASA's capabilities are relevant, beneficial, and practical for disposing of radioactive wastes, then a program should be studies to determine its design requirements, performance, and actual costs. It should then be placed in the candidate mission model.

(8) User forecasters should then examine the likelihood of using NASA's capabilities (the STS) for disposing of radioactive waste materials in space.

(9) Liaison functions should then be undertaken and contacts should be made with the FEO, AEC, and EPA. If any one of these agencies agrees to the use of the STS, then plans and agreements for future missions should be made.

3. <u>User Scenario for the Discovery of New Energy Sources</u>

(1) The Departments of HEW, the Interior, and Commerce, the AEC, FEO, and EPA are elements of the federal government having goals and needs relating to the discovery of new energy sources.

(2) In the future, discovery of new energy sources will remain as an important requirement regardless of whether society becomes oriented toward frugality or consumption.

(3) NASA's capabilities in contributing to these discoveries include:

(a) Monitoring the Earth to locate new sources of fossil fuels

(b) Monitoring the Earth to aid in determining fossil fuel depletion

(c) Monitoring the Earth to locate new uranium ore

(d) Monitoring the Earth to locate geothermal sources

(e) Monitoring the sun and other stars to gather data concerning energy producing mechanisms and processes which could lead to new energy producing technologies.

(4) The use of the relevance filter yields the following observations:

(a) If HEW is concerned with inexpensive energy requirements for low income families, NASA's capabilities may be initially irrelevant but later appreciated if useful and successful.

(b) If the Department of the Interior is concerned with discovery of natural resources (for example, fossil fuels and uranium), NASA's monitoring capabilities are relevant.

(c) If the Department of Commerce is concerned with the impact of new energy sources on business and the economy, NASA's capabilities may be relevant.

(d) If the AEC is concerned with discovery of new uranium deposits, and energy producing processes, NASA's monitoring capabilities are relevant.

(e) If the FEO is concerned with overall energy questions, then NASA's overall monitoring capability is relevant.

(f) If EPA is concerned with discovering clean energy producing systems, then NASA's technical capabilities in the study of energy-producing processes are relevant.

(5) The use of the benefits filter leads to the following conclusions:

(a) If monitoring the Earth for new fossil fuels produces more information than current "hunt and peck" drilling operations, NASA's capabilities provide a performance benefit to concerned users.

(b) If monitoring the Earth for new fossil fuels is less expensive than current drilling and geological methods, then NASA's capabilities provide cost benefits to concerned users.

(c) If studying the stars complements earth-based laboratory studies and energy-producing processes, then NASA offers both performance and reliability benefits.

(d) If earth-based procedures are cost-competitive and technically as good as space procedures, then NASA capabilities offer <u>no</u> benefits.

(6) If NASA's capabilities appear relevant and beneficial to concerned users, and required monitoring equipment is within the state of the art, then NASA's capabilities are practical.

(7) If NASA's capabilities appear relevant, beneficial, and practical for discovery of new energy sources, then a program should be identified to determine actual costs to users and the results they could expect.

(8) User forecasters should then examine and determine the likelihood of using NASA's capabilities to discover new energy sources.

(9) Liaison functions should be undertaken and potential users should be contacted. If the users agree that the use of NASA's capabilities is in their best interest, agreements and plans for future missions should be made.

4. User Scenario for Improved Health Care

(1) The Department of HEW and the Veterans Administration (VA) are elements of the federal government having goals and needs relating to the improvement of health care for the aged, the poor, and all sectors of society at reduced costs to the patients and doctors.

(2) In the future, these goals and needs will remain as a high priority requirement regardless of whether or not society becomes characterized by the values of a Post-Industrial I or II future, or a combination of these values.

(3) NASA's capabilities can contribute to these goals and needs by:

(a) Using communications satellites as an element in a medical data distribution network

(b) Conducting experiments in space relevant to medical problems of concern to patients and doctors

(c) Using zero-gravity and vacuum environments to discover new pharmaceuticals

(d) Manufacturing beneficial pharmaceuticals that require zero-gravity and/or vacuum for their synthesis

(e) Using NASA's data handling techniques for computerized medical history

(f) Using Apollo and Skylab medical data for basic medical research relative to improved health care

(4) If HEW and VA are concerned with various facets of medical data handling for improved health care, then:

(a) Using communications satellites is relevant for use in a medical data distribution network.

(b) NASA's earth based data handling techniques is relevant for use in handling computerized medical histories of patients for improved patient care.

(c) If HEW or the VA is concerned with medical research for improved health care, then:

(i) Conducting medical experiments in space is relevant

(ii) Pharmaceutical research in zero-gravity is relevant

(iii) Use of Apollo and Skylab medical data is relevant for specific problems.

(d) If HEW or the VA is concerned with producing pharmaceuticals in zero-gravity, then the use of space manufacturing techniques is relevant.

(5) If communications, data handling, experimentation, and technology transfer capabilities are relevant applications of NASA's capabilities for improved health care, then associated cost and performance benefits must be determined:

(a) If using communications satellite and earth-based data handling techniques are either cost-competitive with existing techniques or cost-reliable for non-existing techniques, then there is a cost benefit in using NASA's capabilities. Also, if the medical data can be supplied in greater abundance with greater efficiency than through the use of current methods, then there is a performance benefit in using NASA's capabilities.

(b) Similar considerations hold true for applying NASA's capabilities to medical research and technology transfer of medical data from previous Apollo and Skylab missions.

(6) If NASA's capabilities are relevant and beneficial for improved health care, and if these capabilities provide usable data directly to the user without requiring a large technology development effort beyond the current state-of-the-art, then the applications of NASA's capabilities offer practical benefits.

(7) If NASA's capabilities are relevant, beneficial, and practical for improving health care, then a program should be identified to determine actual costs to users and the results they can expect.

(8) User forecasters should then examine and determine the likelihood of applying NASA's capabilities to improved health care.

(9) Liaison functions should be undertaken and contact should be established with HEW and VA officials. If HEW and VA officials agree, use of NASA's capabilities should be planned in terms of future missions.

F. GENERAL OBSERVATIONS

The methodology developed in the course of the SRI study has proven to be germane and effective in its ability to identify potential users and uses of the STS within a changing societal environment. It has been constructed so that it can be readily adapted to be of more general utility than inherent in the original design intent; it can be expanded to treat all potential users (not just those outside NASA and the DoD in the domestic government sector), and it is capable of identifying potential uses for the totality of NASA's capabilities (not just the STS).

The detail that has been given to the methodology in this study is sufficient to validate the above observations; but, it is not sufficient to warrant going directly to the operational phase, Phase III; much Phase II work is needed. The details of the Phase II activities required are given in Section II of this report.

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2. "Study for Identification of Beneficial Uses of Space," General Electric Corp., Contract No. NAS8-28179 (Dec 1, 1972).
3. "Space Shuttle Mission and Payload Capture Analysis," The Aerospace Corp. Contract No. NASW-2301 (June 15, 1973).

APPENDIX A

AN ALTERNATIVE FUTURES CONTEXT FOR SPACE PROGRAM PLANNING

Appendix A

AN ALTERNATIVE FUTURES CONTEXT FOR SPACE PROGRAM PLANNING

1. INTRODUCTION

The relatively long lead time between the conception and execution of major space programs imposes on NASA perhaps a greater need for knowledge of possible future environments (environments broadly considered to include the social, political, economic, and cultural aspects) than most operational, program-oriented agencies of government. Programs planned in the present environment and justified in terms of the apparent needs and priorities of this environment may not prove suitable to the needs of a number of possible futures that could evolve by the time these programs become operational.

Of course, the suitability of a given program could be guaranteed by the planner were he able to shape the future environment appropriately; but, NASA is in actuality an agency which is environment-responsive rather than environment-shaping. This is not to say that NASA activities have no impact; but historically, NASA activities have been undertaken in an environment created by other forces and have essentially consisted of making contributions along with other organizations to satisfying the goals and needs specified external to NASA.

This situation is in contradiction to that for a major social, socioeconomic, or defense institution, such as the Department of Defense (DoD); the decisions made and programs launched by these institutions are themselves important factors in the selection and shaping of possible alternative futures. Not surprisingly, development of the alternative futures concept has been important to the directors of these institutions because it has clarified the effects that their present choices will have an achieving the more desirable of the possible futures in a given time frame. For example, land-use policy decisions made today will inevitably and demonstrably produce, within reasonably accurate limits, tomorrow's population distribution pattern. Energy source decisions made today will

define the pattern of tomorrow's economic activities. However, based on those factors that can now be identified as elements which could shape possible future environments, there is no NASA program, now apparent, that will have such significant or irrevocable impacts that are future determinative. However, at some future time, space exploration and other NASA programs could present such significant opportunities for mankind that NASA program decisions could be important in molding the future. Realistically considered, however, the space program today is not a primary factor in the determination of the future, and the directors of the program can be only secondarily concerned with their role in creating the future; their primary concern should be the role they will play in the alternative futures that might emerge.*

It is from this perspective that the following discussion attempts to describe the development of alternative futures contexts in which the space program will exist. The discussion foresees the possible emergence of two rather distinct future states: Post-Industrial I** future in which industrial-age values, modes, and institutions are accepted, heightened, reinforced, and adapted to provide an accelerated rate of technological and scientific development; and a Post-Industrial II† future in which, for a variety of reasons, industrial-age values, modes, and institutions are rejected, modified, and replaced, partly in response to the accelerated technological and scientific development of our current era.

The present contains elements of both these futures. As time goes on, the trends marking the paths to these two futures necessarily diverge. However, there is a transition period during which the diverging trends

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* Statement of NASA Administrator James C. Fletcher before the U.S. Senate Committee on Aeronautical and Space Technology, March 6, 1973, on the need for, and use of, future forecasting for NASA: "If a business cannot project accurately several years ahead it is just not going to survive. It has to know what the environment is going to be that far ahead."[1††]

** A future emphasizing consumption.

† A future emphasizing conservation and frugality.

†† Superscript numbers denote references listed at the end of this appendix.

are still close enough together to allow a society to "straddle the gap." During this transition period, society may continue to move forward (or, at least, move, as it must, into the future) without making any irrevocable choices. The transition period may be longer or shorter than that indicated; it may be marked either by intense struggle or peaceful co-existence between those urging selection of one path or the other. Furthermore, it is possible that the resolution will not be one of mutual exclusion. A dominant Post-Industrial I society with the attributes mentioned previously for such a society and involving a significant proportion of mankind can develop at the same time that another significant portion of the human race moves toward a Post-Industrial II society. While such a division is apparently unsatisfactory to national and world leaders who are driven by a unifying imperative, this division seems to be, at least in modern times, the usual condition of the world and most of its national subdivisions. For example, while sociologists ponder the possibility of some future other than the existing industrial one that characterizes developed countries and which is considered the norm, it is evident that the majority of the human race lives in the so-called "third world," pre-industrial, underdeveloped condition. Furthermore, there is a "second world" created by the division of the industrial nations into two groups that have distinctive, but similar, values and organizational forms. In addition, highly visible pre-industrial enclaves exist within industrial countries (for example, Appalachia), and modern, industrial enclaves exist within the underdeveloped countries (for example, southeastern Brazil).

In considering the possibility of a divided future, it was concluded that the Post-Industrial I sector must be dominant in order to have any meaningful co-existence because this sector must control sufficient resources and possess enough power to pursue its agenda effectively. The Post-Industrial I sector could pursue its goals without the active support or involvement of those who did not share its goals or values, but would probably be influenced or altered by the existence of a sufficiently large subordinate group. Conversely, a Post-Industrial I future cannot exist alongside a dominant Post-Industrial II future. Without effective control

over resources and the exercise of power, those holding Post-Industrial I values would be impotent and unable to give those values effective expression.

The following sections of this appendix contain fuller characterizations of the two alternate futures identified and a discussion of the use of these characterizations in space program planning. Before presenting this material, however, it appears worthwhile to give a brief description of the current industrial era in order to introduce the reader, in a context familiar to him, to the type of characteristics of interest in this study and to lend implicit credence to the previous assertion that the two alternate futures described are indeed the most probable.

2. INDUSTRIAL ERA

Although the majority of mankind does not hold the values of, or participate in the activities of, the industrial era, the industrial sector has, through necessity, established values, norms, institutions, processes, and disciplines through which it has been able to dominate and direct the world. The present dominance of the industrial sector has developed over the past two hundred years, and has the following characteristics:

(1) Development and application of scientific methods; melding of scientific and technological advances

(2) Emphasis on efficiency and productivity through organization and division of labor, and automation

(3) Acquisitive materialism as a dominant and approved cultural value

(4) Belief in unlimited material progress and technological and economic growth

(5) Manipulative rationality as a dominant theme; man seeking control over nature

(6) Primacy of the individual; economic freedom through the market*

* Not characteristic of socialist industrial societies and in many ways diluted in modern capitalist industrial societies.

(7) Individual responsibility for own destiny; nihilistic value perspective, with individuals determining their own "good;" society as an aggregate of individuals pursuing their own interests*

(8) Delayed gratification, expressed economically through savings and investment, as the manifestation of social and individual virtue

(9) Dedication to work as the approved means of self expression

(10) Adherence to the concept of private property*

(11) Subordination of both the local community and the universal community of mankind to the ideal of the nation state.

During the Industrial Age, men, and the nations they control, have pursued the paradigm above with diligence. In the process they have exploited, with ever-increasing intensity and efficiency, the world's storehouse of non-replenishable minerals and fossil fuels for the purpose of producing, distributing, and stimulating the ever-greater consumption of a wider variety and larger quantity of goods. Increasingly, and most noticeably during the past three or four decades, the pursuit has required, or at least resulted in: the concentration of ownership in non-individual collectives ("private" corporations and state capital organizations); the displacement of human workers in the production processes; the control and direction of scientific development; the elaboration of state social control mechanisms; emphasis on individual spending as opposed to saving, and on immediate as opposed to delayed gratification; and the exposure of all of human society to natural disaster through large-scale violation of the basic ecological processes.

In spite of the fact that most people would view at least some of these developments as undesirable, neither that portion of mankind that is directly involved in and adheres to the practices and values of the industrial era, nor that which is not directly or consciously involved, is by any particular criterion "worse off" because of the experience of

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* Not characteristic of socialist industrial societies and in many ways diluted in modern capitalist industrial societies.

the past two hundred years. In fact, by almost any standard, the average human is a great deal better off than he was two hundred years ago. However, the elaboration of certain trends inherent in the paradigm has resulted in the contradiction of other important aspects of it. For instance, individual property ownership, the necessity of work, and the emphasis on individual saving have been undercut by the rise of the corporation, the automation of production, the use of corporate savings as the major source of investment capital, and the stimulation of high levels of consumption and immediate gratification through advertising. The psychological tensions in industrial and industrializing societies resulting from these contradictions have had enormous social and political effects.

In a less subjective area, the exhaustion, or potential exhaustion, of the non-renewable resources (minerals and fuels) on which not only the growth, but maintenance, of the industrial state depends, increasingly threatens the system. Likewise, some analysts feel that the once menacing nature which science and technology tamed and placed at mankind's service during the industrial era now threatens to lie down and die from overwork.[2] This possibility, remote or distant, realistic of fanciful, as it is increasingly accepted and becomes part of the common conceptual framework, provides another reason for believing that a change in paradigm is inevitable in the near future.

During the industrial era the political environment has been one in which the nation-state has been supreme. In recent years this primacy has been challenged increasingly by international and regional organizations, and especially by the multi-national corporations.

The dominant economic institutions of the industrial era, whether in the free-enterprise or state-directed countries, have been large, hierarchically organized, bureaucratic enterprises that seek to integrate and control their markets either by overt or covert denial of free market principles. Especially since World War II, these enterprises have been characterized by the rapid and highly visible growth of what Galbraith

calls the "technostructure"[3] (the organized activity of scientists, engineers, planners, and managers). The enterprises making up the technostructure comprise the planning system -- in the United States, roughly, the "Fortune 500." The remainder of the economy, the myriad of small enterprises exhibiting the market-influenced, highly-competitive (and highly vulnerable) traits of traditional pre-industrial or early industrial business, are distinctly secondary.

It should be noted that in spite of the early and obvious trend toward giantism and market control throughout the industrial era, that in free-enterprise countries, at least, the very rapidity with which the large corporation has emerged has been itself a major factor in undercutting the basic paradigm. This is especially true in the United States where the ideology of the paradigm has been most venerated, and elaborate machinery based on anti-trust law has been established to enforce it. Coming to terms with this actuality has drastically modified the character of American society--and for less ideological reasons, European society as well--and forced the collection of trend-breaks that has led Peter Drucker to call this the "Age of Discontinuity."[4]

During the early years of the industrial era, the occupational structure of industrializing countries remained largely agricultural. Increasingly, since the mid-nineteenth century, the work force moved, not without significant trauma, into industrial production. However, in accordance with the industrial era imperative of introducing labor-saving machinery wherever possible and harnessing technology and science to this end, the need for human labor in production has decreased rapidly. The elaboration of the tertiary (service) sector of the economy has provided employment for those displaced or denied opportunities in the industrial sector.[5] As a result, a large industrial era population has been created that is not engaged in, nor is knowledgeable of, the manufacturing, or for that matter, the agricultural processes on which they depend. Furthermore, only a very small percentage of the population has any ownership in industrial enterprises; except as consumers, the mass of people in industrial countries have little real connection with industry.

Industrialization has proceeded in almost every conceivable political environment. The values of the industrial era are (nationalism aside), by and large, apolitical. The fact that the most fully developed industrial nations have some form of representative government probably results from the fact that, like other citizens of such states, scientists have been freer, in accordance with the value-free scientific ethic of the industrial age, to pursue their goals and disseminate their findings. It also seems to be true that, regardless of political form, where the entrepreneur has been free to follow the ethic of acquisitive materialism, industrialization has been most rapid.

Another possible reason liberal democracy and free enterprise have enjoyed such a synergistic relationship during the industrial era is that the citizens and government officials were engaged in a continuing political struggle over chiefly non-economic issues (suffrage, limitations on the police power, states rights). As a result, the apolitical scientist and entrepreneur were free to pursue their goals almost undisturbed. However, the very success of industrialization inevitably and increasingly meant that "business" matters were transmuted into matters of public and governmental concern. Furthermore, the relatively small number of large firms that characteristically dominate the economies of industrial countries are, even though more powerful, more visible and thus more amenable to government regulation and control. (In eastern Europe, the industrial enterprises are state-owned and directly controlled by government.)

The discussion above indicates that, in some respects, the industrial era has reached the limits of its paradigm and is threatening to overrun them, while in other respects, it has violated and contradicted some of the most important tenets and values upholding the paradigm. On the one hand, society is straining to overthrow its cultural walls; and on the other, because of internal tensions and stress, it is being threatened with the inward collapse of those same walls. In other words, major change is imminent and inevitable in society, and the change will not be a mere passage through a door. There will be some damage to the

existing societal structure as we move out of the industrial age into that which will succeed it. Care and prudence, planning and foresight will be required to make sure that the institutions of the present age that will be useful and necessary in the future are not damaged or destroyed during the period of transition.

NASA is one of only two institutions* attempting to extend the boundaries of mankind's endeavors beyond the earth and to use the resources and knowledge to be found there for humanity's benefit. In view of its usefulness in the future and its nearly unique character, it is, therefore, one of the institutions which should be preserved.

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* Only the US and the USSR space agencies have attempted exploration outside the Earth's biosphere.

3. POST-INDUSTRIAL FUTURES

In Section 1., two general post-industrial futures were outlined with reference to the existing industrial era described above in Section 2. This section describes both of these futures in terms of ten characteristics most significant to their dominant ethics. Although these characteristics do not form a complete set of descriptors, they are sufficient to permit the inference of values from which, in turn, some of the restraints on, and opportunities for, a continuing space effort were derived. Neither future was found to be internally completely consistent. However, because the future must evolve from a demonstrably inconsistent present (see Section 2), the discovery of contradictory tendencies was expected and was regarded as a sign of validity, not of erroneous analysis.

a. Post-Industrial Future I

One future toward which the industrialized world, and particularly the United States, seems to be moving is one in which the value system of the present has been re-evaluated and transcended. Faith in value-free science is reaffirmed and there is confidence that technology has a role in man's struggle for survival. The continued rise of a meritocratic, technocratic, professional, co-opting elite ensures the continuation of permanent hierarchical institutions organized on rational principles. Economic growth is likewise endorsed as a supreme guiding principle for policy formation.

Competition, not so much between producers of like goods for the favor of buyers in free or uncontrolled markets, but between rival institutions seeking access to credit, raw materials, and technically competent personnel, remains as a functional value.

These features are more or less distinctly delineated in today's industrial society and seem to be growing more prominent. Another feature of the industrial era, the drive to control nature, will continue but in transmuted form. The environment will be respected and tended

more than ever; however, there will be no romanticization of any ecological ethic. Resource management, not natural harmony, will be the theme and justification.

Rational management, technocraticism, and meritocratism share an imperative that drives toward consolidation and control and a need for tidiness in human affairs. In a Post-Industrial I future, the value placed on the individual as a free (although untidy) being will be subordinated to a value that still sees him as free, but only in the sense that he is free to function and to rise in the meritocratic hierarchy. Society will not be viewed as an aggregate of individuals pursuing their own interests. It will be a society recognizing that it is composed of individuals grouped into institutions and pursuing institutional interests that not only take precedence over the interests of the individuals, but that are, effectively, the interests of those individuals.

In such a future there will be no need to rationalize the discrepancy between an ideological requirement for (individual) private property in the production sector and the actuality of corporate control of the vast majority of the means of production. In one way or another, the Post-Industrial I future economy will find a means for sublimating individual property in the collective either by property in the job, universal shareholding (either a la Kelso[6] or in some other form), or by profit sharing.

Certainly, it would follow that the submergence of individual property in the collective negates the value of individual thrift and saving. Savings will be corporate savings, and the individual function of consumption will be transformed from a guilt producing to a self-fulfilling and necessary positive act. Hence, delayed gratification, except as expressed in preparation for higher technocratic tasks, is an industrial era ethic that can safely be dumped.

Richard Goodwin has recently argued that the nation-state has been necessarily the political expression of the industrial era.[7] Both the local community, as the actual locus of political life, and the universal community of mankind, as the ideal of political organization, have

been subordinated to the nation-state. It is certain that the Post-Industrial I future will be no less hostile to the local community. Whether or not it will be any more friendly to the sense of world community is problematical. During a period of transition to a Post-Industrial I future, it would seem that the power of the national ethos and its reinforcement by competition and institutional continuity would prevail, and that the super-industrial future would be one of continued nation-state organization and rivalry.[8*] Since, however, earth resource management is both a requirement and a value, the rules of competition and rivalry among nations functioning in a common environment and economy would tend to be as restricted and artificial as those governing the major industries operating within an oligopolistic market. That is, by agreement, competition will not threaten the survival of any of the competitors. In this sense, the rationality of the Post-Industrial I future will yield to some unreality in ideology.

Given this sketch of a Post-Industrial I future, the planner of space programs might consider how he should design, present, and justify space programs in such a future, or during the period of transition in which at least some of its traits are present. Presumably, public opinion, even though it will be expressed more in collective than individual form, will still exist and will influence the selection of societal goals. Since public opinion may be viewed as directly reflecting the values held by society, the values held in any future will therefore present certain opportunities for, and pose certain threats to, or restraints on, space programs. In a Post-Industrial I future, the wise program planner will exploit the opportunities, defend against the threats, and seek to escape from, or overcome, the restraints in the interest of achieving his objectives. Fortunately, as will be seen, this does not require a meretricious hyper-responsiveness that approaches pandering to moods of the moment. This is indeed fortunate for NASA, where typically, long time intervals are required between program definition and operation.

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* Argument for a revived neo-merchantilism.

The following paragraphs describe characteristics, inferred from the values assigned to the Post-Industrial I future, which illustrate how appropriate opportunities and restraints may be conceived and utilized in planning long-range programs.

1) High Value on Consumption (1A)*

If a high value is placed on consumption, as in a Post-Industrial I future, opportunities will be present for the space program to assist in the discovery of new resources to support a high level of consumption. In addition, the development of space technology for production processes (the basis for high levels of consumption) will be encouraged.

Other opportunities (such as the control of the world traffic of goods from space to expedite delivery, reduce distribution bottlenecks, and prevent temporary shortages, and the space program's ability to provide high-skill, high-pay jobs to support high individual consumption levels for workers,[9] as well as being a high and conspicious consumer itself) will enhance the probability that a viable space program would be supported.

However, the space program may well use limited raw materials that might otherwise be used in the manufacture of consumer goods, and it takes money, in the form of tax dollars, from consumers. These factors and the fact that the space program does not directly provide consumer goods can inhibit the space effort during a Post-Industrial I future.

2) High Value on an Objective and Pragmatic Reality (2A)

Since the space program is hard science oriented, it should flourish in a future which promotes an abjective, pragmatic philosophy in solving technological problems. In addition, the space program can

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* Post-Industrial I values are coded for later analytical purposes by "A" preceded by an arabic numeral.

provide large quantities of data in real time which will be needed for pragmatic decisions or actions, especially in the areas involving resource management. (The long-range perspective embodied in the space program conduces toward an objective, unemotional view of the planet.)

In order to survive in the Post-Industrial I future, however, justification for space programs must be precise and scientific; non-specifics will not be accepted easily.

To be in consonance with this value, more emphasis should be placed on applied science than pure science, and high risk ventures should be avoided. In addition, this objectivity calls for cost consciousness; the space program will have to justify itself economically in a Post-Industrial I future in which institutions compete for funding, personnel, and materials.

3) <u>Decisionmaking by a Small Meritocratic Elite Group (3A)</u>

If space planners can justify a program on merit* in this future, there will be more opportunities for long-range programs because decisions will be made more quickly, and decisionmakers will tend to remain committed to their decisions. In addition the decisionmaking elite will tend to share (to a high degree) the same values; in which case, the space program would need not be diluted to serve too wide a variety of interests as has sometimes been the case in the past. Since the decisionmaking group has the ability to concentrate resources on those programs it favors, long-range programs, such as space efforts, would have more opportunities to pursue their goals.

However, getting a hearing with an elite decisionmaking group may be difficult, and there will be little chance of appeal to a wider public. In addition, the space program could be inhibited if the decisionmaking elite did not find merit in the planned space programs: a

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* That is, if space planners can demonstrate that a program is positively supportive of societal values.

closed, self-reinforcing decisionmaking group tends to be disinterested in expanding frontiers since this would involve expanding the decision-making group and diluting the power of the individuals in it. The narrow spectrum of goals in this future could also reduce space program options.

4) High Value on Growth (4A)

In a future that values growth, almost any activity that increases the Gross National Product (GNP) is *ipso facto* justified. Accordingly, the space program has many unique opportunities for promoting growth: (1) it can supply the data required by a growth economy; (2) the space program's growth imperative is not limited to earth; (3) it provides jobs for a growing labor force; and (4) a growth economy relies on the technological fix, for which the space program is a dramatic symbol.

The space program could get less support in the Post-Industrial I future, however, if alternative opportunities for the investment of public or private moneys show more economic growth potential.

5) Nationalistic Values Dominate (5A)*

In a Post-Industrial I future in which nationalistic values dominate, the space program can maintain its traditional justification as a primary means of national glorification while promoting its capability for intensive gathering military intelligence information. Exploitation of these "flag and security" themes could insure a continued high level of funding and provide a blanket under which a variety of valuable space projects could be carried out without need for detailed justification.**

* The previous discussion regarded it as very possible that supranational values might prevail in the Post-Industrial I future. However, nationalism was regarded as the more likely value. This is an area where trends during the transition period should be watched carefully.

** This theme was sounded in several interviews in which individuals otherwise skeptical of the value of the manned space flight program to them or their agencies were willing to support it, no questions asked, on grounds of an assumed higher national purpose. (See Appendix B)

In addition to being a symbol of national independence, the space program provides a means for discovering and monitoring resources that provide the basic for economic independence (as in the current energy program). This capability could assist in maintaining national control over multi-national corporations in the world economy.

The inhibiting influences that would come from a nationalistic environment would be: (1) a space program justified in terms of national security will tend to fall under the control of the military; (2) the inherently global and universal space program requires international cooperation which could be regarded with suspicion by a nationalistic society and reduce the availability of necessary foreign cooperation with the space program (satellite tracking stations, participation of foreign scientists, etc.).

At the same time, the theme of world interdependence seems to be running so strongly in the future that a nationalistic space program could find itself an anachronism, if it had to be justified in terms of clear-cut national goals.*

6) Permanence of Institutions (6A)

If the permanence of institutions is encouraged in this future, an existing space program would probably be continued; however, it could be restricted to current missions.

7) High Value on Competition (7A)

In a competitive society, there will be faith in the advantage given by advanced technology. The space program will be courted and supported by those seeking to gain this advantage.

At the same time, however, the space program will be competing with other institutions in a variety of ways--for personnel, resources,

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* If dominance of nationalistic values does not accompany the other values given here for a Post-Industrial I future, then the opportunities and restraints listed under value 5A are not appropriate and should be supplanted with those more appropriate to value 5B of the Post-Industrial II future.

money, and public support. Considerable effort, not really related to the NASA mission or suited to the scientific image, may be expended in this competition. In fact, the advantage given by advanced technology could be diminished in the process.

8) Education Valued as Training and Socialization (8A)

The space program could count on a flow from schools and colleges of appropriately trained specialists, who are conditioned to meeting program requirements if socialized educational training were promoted. However, the space program would be less likely to receive the type of critical, unorthodox person whose willingness to break rules and to disregard stereotyped thinking leads to new concepts and technological breakthroughs.

9) Knowledge Considered as Property (9A)

The space program will be acknowledged as an important source of knowledge for commercial industries, but it will have to operate in a highly compartmentalized fashion in order to protect the proprietary secrets and processes of its suppliers and clients. Private industry could charge the space program with actual or potential "unfair" competition as it becomes more compartmentalized.

10) Value-free (Morally Neutral) Science (10A)

Obviously, a space program required to justify itself only in terms of expanding the frontiers of knowledge without assessing any of the potential societal or environmental impacts of such expansion will be able to operate freely and without effective outside criticism. Therefore, the space program is not subject to restraint from this value. Note, however, that other characteristics such as 1A could result in restraint of a new-knowledge-only space program.

b. The Post-Industrial II Future

In current usage the term "post-industrial future" or "post-industrial age" would usually be associated with a future or age like

the one described above under the rubric "Post-Industrial I." As discussed by Daniel Bell and others, it is an intensified version of our present highly developed industrialism[5] but is more totally dependent on the functioning of great industrial agglomerations and is committed to industrial age values purged of tension-producing anachronisms such as the need for personal savings, delayed gratification, and the priority given to private ownership and individual goals over corporate ownership and institutional, or collective goals. The chief difference seems to be that only a small minority of the people in the society are directly engaged in the industrial process or understand it; they are consumers of its products. Insofar as they are engaged in the provision of services, their function is to assist in the distribution and repair of industrial products, to encourage others to use them, to instruct others in their use, and, in some instances, to minister to those who are redundant to the industrial production process and who cannot, or do not, develop the skills required in the service sector.

In contrast, a Post-Industrial II society (perhaps a more accurate term would be counter-industrial society) is a more relaxed and far less intensely organized civilization. Its values and the economic, social, and political institutions that express them rest on a dominant ethic comprised of two complementary parts. One is an ecological ethic emphasizing the total community of man in nature and the oneness of the human race; the other, a self-realization ethic, places the highest value on development of the individual, holding that the basic function of social institutions is to create an environment for the development of individual human potentialities. Together they allow for both cooperation and constructive competition for the community and for the individual. They present a view of man as imbued with a sense of universal brotherhood and with a holistic view of the world, but as functioning within local communities.[10*]

Institutional goals (growth, profit, survival, and prestige) will not be eradicated because they are ineradicable, but they will be

* This world view has been expressed by several other authors.

subordinated to (local and world) community goals that contribute to the welfare of the society, provide individual satisfaction, and foster the growth of those people who compose the institutions. In consequence, the so-called technological imperative is superseded by a social imperative that requires assessment of scientific effort and technological development in terms of their contribution to the ideal of individual growth and fulfillment within the community.

To achieve this end, all members of the society must be educated to the fullest so that they can participate effectively and meaningfully in choosing their futures. They will not be presented with predetermined situations to which they only adjust; they will choose. Such participation places an immense responsibility on each individual. In order to assume this responsibility, education will be used not only to prepare youth for adaptation to, and entry into, a world made by others, but to continually educate all individuals throughout their lives.

The knowledge paradigm in this counter-industrial future has the following characteristics:

(1) Complementarity of physical and spiritual experience; recognition of all "explanation" as only metaphor; use of different non-contradicting "levels of explanation" for physical, biological, mental, and spiritual reality, thus resolving such dichotomies as the conflict between science and religion, or free will and determinism.

(2) Teleological sense of life and evolution having direction and purpose; ultimate reality perceived as unitary with transcendent order.

(3) Belief that knowledge is discoverable through individual inner experience with a hierarchy of "levels of consciousness;" recognition of a potential for supraconscious knowledge as well as subconscious knowledge.

In order for this future to become a functioning reality, it is obvious that certain conditions which exist in industrial societies must change. Some of these are enumerated below:

(1) The use of materials and energy, economic productivity, and growth, as defined previously, will have to slow down drastically. (This in no way implies

limiting productivity in another broader, less narrow economic sense, nor of the growth of knowledge and understanding.)

(2) Technological development and application must be guided by broad, human, and ecologically-sound, future-oriented social goals. This requires a participative process in which private and public institutions assume social responsibilities for employees, consumers, and the public at large, as well as to stockholders; that is, it requires business "deriving its just powers from the consent" of all those impacted by it.

(3) The relationship between individuals and institutions must be improved by cultural changes. A family-like relationship in which the authoritarian figure and the individuals in the institution work together for mutual benefit and understanding is desirable.

(4) The work delemma (shortage of social roles) will require perhaps the most difficult cultural change of all, since it necessitates reconceptualizing the role of work in a society where goods can be produced largely by machines. The resolution appears to be in providing structured work opportunities for all those who, in their own stage of development, seem to want and need them, and to arrange for sabbaticals and scholarship-type opportunities for those who want to follow educational (self-development) pursuits or experiment with new careers.

(5) The gap between the rich and poor nations will tend to be reduced somewhat as those lesser developed countries (LDC's) possessing sources of raw materials organize for greater economic and political influence within the world system. However, the economic goals of the LDC will include much more than quantitative growth, since growth alone under modern conditions cannot guarantee full employment, stable prices, equitable income distribution, and enhanced quality of life.[11] The LDC may have to adjust perhaps even more rapidly and radically than the now developed nations to the new values, in order to co-exist with them in a Post-Industrial II future.

This sketch of a Post-Industrial II future presents only the most salient and obvious features. Also, since it represents a very distinct break with the present in contrast to the Post-Industrial I future, it is necessarily more speculative. With this caveat in mind, ten values

inferred from the characteristics of this counter-industrial future, were assigned and a set of potential opportunities and restrictions which they present for the space program are described.

1) High Value on Frugality and Conservation (1B)*

In a society in which frugality and conservation are emphasized, there will be opportunities to utilize the whole range of earth monitoring capabilities provided by the space program to prevent waste of both renewable and non-renewable natural resources. Additional opportunities will arise because the space program provides an outlet for scientific and technological drives that might otherwise be employed in more wasteful defense or consumer industries. However, since the space program appears to he a highly visible consumer of scarce resources, it will be required to justify itself in very specific and earth-related terms, or its consumption will be reduced or eliminated for the sake of frugality.

2) High Value on Subjective Reality (2B)**

The space program will be supported† as an experimentive and nonpragmatic, spiritual activity, or for romantic exploration (a la Star Trek) in a subjective society. However, pursuits of this type could potentially cause rejection of the space program as a symbol of science (see characteristic 10B). In addition, subjective values tend to be associated with a short attention span, and a dilettante attitude that will not support long-range, detailed programs requiring fixed commitments of resources and people over long periods of time. If this type image were allowed to prevail, the space program would have difficulty justifying its existence.

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* Post-Industrial II values are identified for later analysis by "B" preceded by an arabic number.

** As opposed to objective reality.

† As a possible indication, note the activities of former astronaut Edgar Mitchell and the Institute for Noetic Sciences.

3) High Value on an Open, Participative Power Structure (3B)

In an open participative power structure, there would be more willingness to experiment with new and untried approaches; enthusiasm and responsiveness would tend to be higher, at least in the short run. This open power structure will give the space program a potentially larger group of supporters who could make their influence felt, and space program planners could organize such mass support more effectively than a Post-Industrial I future. With mass support, a broader range of space science applications for public use could be planned.

The negative aspects which could result from an open power structure are:

(1) A space program that must please everyone will please no one.

(2) The open power structure is unwieldy and slow to respond by its nature.

(3) The open power structure, because of its tendency toward rapid change in composition, is disinclined to long range commitments and inclined to reverse itself; this would complicate space program planning.

4) High Value on Optimization Instead of Growth (4B)

The space program's ability to provide a continuous inventory of earth resources and to monitor their uses is essential to optimization.

Furthermore, since optimization implies efficiency in the holistic sense, the space program, with its low tolerance for error and emphasis on efficiency in space, not only symbolizes this value but provides optimizing management skills which enhance justification of the space program's existence.

On the other hand, the optimization value is not conducive to expansion. While the existing space program might be maintained, it would probably not be allowed to grow. In addition, the diffusion of resources to optimize all segments of the existing economy would not permit the concentration of resources necessary to support a major space effort. Other space program assets, such as the generation of new data,

would also be diminished, because a society committed to optimization is more inclined to analyze and draw the fullest implications of existing data rather than to support the generation of more.

5) High Value on a Supra-national* Community (5B)

The space program is inherently and symbolically of a supra-nationalistic nature. In addition, a space program's capabilities for exploring and monitoring global resources and for involvment of the world community in a common effort at low cost and low risk, lend themselves to supra-nationalistic uses. A future which emphasizes supra-nationalistic values places at the disposal of the space program a greater number of users, supporters, and talents; and this will allow the space program to escape some of the restrictions on its activities imposed by national security considerations.

Some of the factors which could inhibit the space program's growth or survival in a Post-Industrial II future holding supra-nationalistic values are:

(1) The supra-nationalistic value brings into question the propriety of a national space program.

(2) Nationalistic values have proven effective in mobilizing support for a space program. It is questionable whether the supra-nationalistic value will support continuing the program or mounting new efforts.

(3) A space program, while perhaps appropriate for a rich nation, might be considered an inappropriate luxury in a world of general material poverty.

(4) The supra-nationalistic value implies further broadening of the decision base, thus complicating and retarding the processes of planning and decisionmaking for a space program that demands long-range, continuous, reliable, and informed planning decisions.

6) High Value on Institutional Change and Flexibility (6B)

If a Post-Industrial II future were to support institutional change and flexibility, the space program would be released from many

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* Note that, even today, the supra-national value is being reinforced by the drive of multinational corporations to create a world economy.

imperatives that would be imposed by another future. For example, it could be relieved of the imperatives for growth, self-justification, and perpetuation. The space program could consequently find greater opportunity for service to the whole community.

However, in a continuing environment of change, constant institutional reorganization would impede the planning and conduct of the space program; without assurance of continuation of an institutional framework, the space program would tend to be a mere collection of unrelated missions. In addition, institutional instability would make if difficult to attract qualified people into the space program. Furthermore, without institutional continuity there would be a continuing, repetitious, and wasteful requirement for rejustification of the space program.

7) <u>High Value on Cooperation (7B)</u>

The space program would benefit from sharing more resources with other institutions and nations. This in turn would encourage wider public support for the space program, because the benefits of scientific research would not be used to strengthen certain groups at the expense of others. At the same time, competition with other science-related institutions for resources would be relaxed. In addition, there would be easier transfer and loan of personnel and facilities for use in the space program. However, if there were open sharing with other agencies, the space program might well be a net loser of talent and other resources. Also, on a world scale, the removal of the threat of competition removes some of the historically most effective justifications for the space program itself.

8) <u>Education Valued as a Contributor to Personnel Growth and Fulfillment (8B)</u>

The space program will benefit from a system of education that encourages a continuing desire to learn in individuals, because the space program can offer a life-long learning milieu. People educated in this manner will tend to support and participate in the almost limitless opportunity for exploration represented by the space program. It is also

likely they will want to expand the program in order to allow for more participation. In the context of education for growth and fulfillment, the space program could be justified on grounds of providing a mass learning experience without reference to any particular cost benefit.

The following statements enumerate some of the education factors which would inhibit the space program:

(1) This system of education will make it difficult to maintain continuity of employment in a necessarily highly specialized and disciplined space program.

(2) People educated to seek self-fulfillment are unlikely to get satisfaction from institutional achievements.

(3) This style of education typically encourages continual questioning and analysis of purpose was well as need for participation in the decision process. Since the long-range nature of the space program requires continuing adherence to firm decisions, it cannot function efficiently in the face of continued questioning of purpose of those engaged in it.

9) High Value on Personal Privacy With a Requirement for Free and Open Dissemination of Knowledge* (9B)

The space program as one of the more open activities of government should be at a comparative advantage in seeking support in a system that values free and open dissemination of knowledge. At the same time, the indirect and impersonal techniques available through the space program become even more valuable** under conditions where concern for personal privacy makes gathering of certain information (for example, the census) difficult. However, the surveillance capabilities of the space program will cause it to be disfavored by those valuing privacy.

10) High Value of Socially Responsible Science (10B)

The space program could be supported as a symbol of public science for the use of mankind. Through the technology transfer program,

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* The two apparently conflicting elements seems to contribute to a unity.

** Interviews with members of the U.S. Bureau of the Census substantiate this point (See Appendix B).

has a unique capability for assessing the effects of a technology before putting it into the hands of users and for monitoring the effects of technology on the total environment. The space program also has the unique capability to apply new technologies for developing goods in space, thus minimizing harmful effects on the earth.

In order to survive under the rubric of a socially responsible science, however, the space program will be under increased pressure to justify itself in terms of its contribution to social welfare, and it will be required to present guarantees of non-harmful effects on the Earth or its atmosphere.

4. USE OF OPPORTUNITY/RESTRAINT SCENARIOS FOR SPACE PROGRAM PLANNING

The foregoing discussions of opportunities and restraints for the space program resulting from the emergence of either of the two futures postulated are, obviously, neither totally inclusive nor mutually exclusive. They are presented as exemplars only.* The material presented does, however, explicitly show the type of information that can be generated and the detail to which it can be specified. This section demonstrates several ways in which the futures data can be used for planning programs and gaining the most effective support for them in a variety of environments. As is the case with the derivation of the restraints and opportunities, and for that matter, the descriptions of the futures from which they were derived, these methodologies result from a largely subjective process. Yet, they are designed to be used objectively in decision-making. Unsatisfactory as this may seem, in the final analysis, all estimates of situations in which human beings, their preferences, and their social expressions of those preferences play a significant part, are themselves highly subjective, both in process and result. However, if systematic and objective means for dealing with this subjectivity are developed, the probability that the space program can adapt to and serve any future society will be increased.

a. Requirements Unique to Alternative Futures Context

It has been stated previously in this appendix that the wise program planner will exploit the opportunities, defend against the threats, and seek to overcome the restraints presented by the environment in which the program is to be undertaken. In the case where that future environment can be uniquely determined to be either Post-Industrial I or Post-Industrial II,

* It must be re-emphasized here that the two futures presented are not the only conceivable or possible alternative developments; although, they are considered the most likely. Others could be elaborated; however, since the purpose of this study is to present a methodology in which futures forecasting would play a part, it is the method of futures utilization rather than the elaboration of alternatives that is here presented. Obviously, the same process of description, analysis, and restraint/opportunity development can be applied with any number of futures.

this guideline leads to a rather straightforward approach: only those programs are planned which reinforce or contribute positively to at least one of the value characteristics of the future and which are minimum in their countervalue characteristics. For example, in a Post-Industrial I future context, a program which appears viable is a low-cost monitoring activity to identify new earth resources. It appears viable because it contributes positively to value characteristic 1A (by contributing to enhanced consumption) while minimizing the countervalue contribution to that same characteristic (by placing as small a demand as possible on raw materials used for consumer goods). In the language of the opportunity/restraint dichotomy, such a program takes advantage of the opportunities afforded by the characteristic 1A and is structured in accordance with the corresponding restraints.

Inasmuch as the justification for any candidate program will emphasize the positive (opportunity) aspects, it is obvious that, as long as the restraints are properly recognized and accounted for, the probability of program acceptance and implementation increases the larger the number of value characteristics to which it contributes positively. The same holds true for a program in the real-world situation where the future will contain elements of both Post-Industrial I and II futures in the transition period between now and the time society can be characterized by only one of these futures. However, since the long time intervals between NASA program definition and realization will span at least a portion of the transition period where characteristics of both futures will be present in a way that the dominant values will probably be changing from those of one future to those of the other and then back again, it is imperative that only those programs be planned that contribute, individually, to the value characteristics of both futures. That is, until it is clear* as to what single future will result (dominate), NASA should design its programs to take advantage simultaneously of the opportunities in each of the futures described. Likewise, however, this program planning activity must recognize the restraints present in both

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* Not only to NASA but to the potential users of NASA capabilities.

futures: a program should be planned so as to simultaneously minimize its countervalue characteristics in both future contexts.

The following paragraphs describe a few techniques which allow the program planner to identify those programs that take advantage of opportunities simultaneously in both futures while minimizing the negative attributes when viewed in either context. The presentation is made in the context of only two alternative futures; but the techniques can be generalized and applied to any number of possible futures.

b. Characteristic Value Comparison

The ten value characteristics of the two futures discussed in this appendix are listed in Table A-1 as contrasting pairs. When viewed in this way, it would appear at first glance that it would be impossible to plan a program that could be justified in the context of both these futures: a justification based on the positive contribution in a Post-Industrial I environment would apparently be viewed as countervalue oriented in a Post-Industrial II context. Such is not the case, however, as can be deduced from a look at Sections 3.a.1) and 3.b.1) of this appendix where it is seen that some commonality in opportunities exists between these two futures even for the two conflicting value characteristics 1A and 1B.

Thus, it is clear that a study of the opportunities for, and restraints on, NASA programs is needed for final determination of the suitability of a given program: these items derived from the value characteristics need perusal, rather than the characteristics themselves. However, an initial test of the applicability of a particular program simultaneously to both futures is possible in terms of the value characteristics. This technique is outlined below.

Table A-2 is a matrix which expresses the conflicting or supportive relationships between the various value characteristics of the two different futures. A plus (+) entry in a given square indicates a supportive or, at least, a nonconflicting situation. For example, Objective Reality (2A) is not in conflict with Thrift (1B). A minus (-) entry indicates a conflicting situation. For example, Growth (4A) seems to

Table A-1

CONTRASTING PAIRS OF VALUE CHARACTERISTICS

Characteristic of Post-Industrial I Future		Characteristic of Post-Industrial II Future	
1A:*	High Value on Consumption	1B:*	High Value on Frugality and Conservation
2A:	High Value on an Objective and Pragmatic Reality	2B:	High Value on Subjective Reality
3A:	Decisionmaking by a Small Meritocratic Elite Group	3B:	High Value on an Open, Participative Power Structure
4A:	High Value on Growth	4B:	High Value on Optimization Instead of Growth
5A:	Nationalistic Values Dominate	5B:	High Value on a Supra-National Community
6A:	Permanence of Institutions	6B:	High Value on Institutional Change and Flexibility
7A:	High Value on Competition	7B:	High Value on Cooperation
8A:	Education Valued as Training and Socialization	8B:	Education Valued as a Contributor to Personal Growth and Fulfillment
9A:	Knowledge Considered as Property	9B:	High Value on Personal Privacy with a Requirement for Free and Open Dissemination of Knowledge
10A:	Value-Free (Morally Neutral) Science	10B:	High Value on Socially Responsible Science

* These alpha-numeric codes were assigned to the value characteristics for use in further analyses. Post-Industrial I values are indicated by an "A" preceded by a number; Post-Industrial II values are indicated by a "B" preceded by a number.

Table A-2

ANALYSIS OF CONFLICT BETWEEN VALUE CHARACTERISTICS
OF DIFFERENT FUTURES

Value Characteristic of Post-Industrial I Future		Value Characteristic of Post-Industrial II Future									
		1B	2B	3B	4B	5B	6B	7B	8B	9B	10B
	1A	−	+	+	−	−	+	−	−	?	+
	2A	+	−	+	+	+	+	−	−	−	−
	3A	+	−	−	+	+	−	−	−	−	−
	4A	−	+	+	−	+	−	−	−	−	+
	5A	+	−	−	+	−	−	−	−	−	−
	6A	+	−	−	+	+	−	−	−	?	−
	7A	+	+	+	−	−	+	−	−	+	−
	8A	+	−	−	+	+	−	+	−	−	+
	9A	+	+	−	−	−	+	−	−	−	−
	10A	−	−	?	−	+	+	−	−	−	−

\+ = No conflict apparent

− = Conflict apparent

? = Uncertain

be in conflict with Thrift (1B). Where the situation is not clear, a question mark (?) is entered.

The utility of this table in program planning during the upcoming transition period lies in its ability to identify those aspects of a proposed program that adapt well to either future, and thus, those for which planners can expect support. Accordingly, the matrix also indicates areas of possible conflict for which the program planner must incorporate alternatives or instigate plans for changing conflicts into assets. For example, a program which can be characterized by being dominantly supportive of Growth (1A) in the Post-Industrial I future can probably gain support in a Post-Industrial II environment by being structured to support the value characteristics 2B, 3B, 5B, and 10B; e.g., in part by being structured to be socially responsible (10B). On the other hand, particular attention will be required to minimize the countervalue nature of such a growth-related (1A) program with regard to 1B, 4B, 7B, 8B, and 9B; e.g., the program should be structured to serve as much of user community as possible in order to avoid conflict with the high value placed on cooperation in a Post-Industrial II context (7B).

c. Opportunity/Restraint Analysis

As indicated previously, the use of the value characteristics alone in some techniques, such as the use of Table A-2, is insufficient to identify the existence of all possible value-reinforcing characteristics available to a given program. A study of the individual opportunities derived from the value characteristics is needed.

As indicated above, those opportunities characteristic of both alternative futures (for example, the need for resource monitoring) will be most significant to the program planner. Crudely stated, these opportunities have a higher conditional probability since they are compatible with either alternative future. These opportunities are labeled as "first-order" as are restraints common to both futures. Those restraints and opportunities reflected by more than one characteristic of one future only have a lower conditional probability and are designated "second-order." The lowest conditional probability is assigned to those restraints and opportunities that

derive from only one characteristic of only one future; they are, "third-order" probabilities. The use of these opportunities and restraints is further discussed below.

1) First-Order Probabilities

During the transition period, assuming that the space program planner accepts the postulates that NASA's program is not more than marginally future determinative and that there is a strong probability that NASA will survive and function in either future,* the program planner can promote a viable space program with the highest probability of success in the transition period by using first-order opportunities. Doing so guarantees continuity of the value-reinforcing attributes of the program. Structuring the program to minimize the countervalue attributes by taking into account only the first-order restraints given below, however, is not sufficient. At any point in time it is anticipated that restraints of the second and third order will also be in effect. Failure to ameliorate their impact could well lead to the demise of a program even if it were based on first-order opportunities. The first-order restraints listed below, therefore, constitute a minimum set to be considered in program planning; but they by no means form a complete set.

a) First-Order Opportunities

The demand for more and better information of a particular nature will be strong as a result of the characteristics of both the alternative futures discussed here. In general, this information will be of the earth--its resources and environment. The present society already considers data and access to such information extremely valuable. In either the Post-Industrial I or Post-Industrial II future, the demand for more and

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* Obviously, these assumptions are critical to this whole analysis. The first assumption allows the planner to be passive because he does not have much influence over the determination of the future. The second assumption allows him to see hope in either future; therefore he does not have to spend all his effort assuring the future in which he could survive an effort which the first assumption says is probably futile. Indeed, if the second assumption is not valid, this study is little more than an academic exercise.

better information of this type is likely to increase. The characteristics of both worlds from which this demand emerges are:

(1) Location of new sources of natural resources (1A,5B)*

(2) Development and monitoring usage rates of existing resource supplies (1A, 5A, 1B, 3B, 5B, 7B, 10B)

(3) Movement of goods and commodities through the global system (1A, 5A, 1B, 4B, 5B)

Another area of first-order opportunities exists in quite a different area. There is, and will be, a growing demand that the scientific community should turn to activities that will yield direct benefits for society. This creates the following first-order opportunities:

(1) Public science and its management (1A, 4B, 10B)

(2) Provision of opportunities in public science (1A, 4A, 3B)

A third area of first-order opportunity exists in both futures in the demand for increased opportunity for the performance of beneficial and self-fulfilling work roles. While NASA has always encouraged the active participation of scientists outside the space program and the passive participation of the general public, this aspect could be broadened and become more meaningful.

b) First-Order Restraints

Compared to opportunities, first-order restraints are fewer in number. However, they are potentially more powerful because of the historical tendency in any society for negative considerations to outweigh the positive.

All three first-order restraints are related to one major question: Is the space program worth the continued investment of billions of dollars annually? As the demand for government spending in other areas

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* The codes in parenthesis in this section refer to the values listed in Table A-1 for the Post-Industrial I and Post-Industrial II futures.

continues to grow--an assumption common to both futures and to the transition period--the space program planner will find increasing stiff competition for funds. The first-order restraints are:

(1) Competition for resources (1A, 2A, 7A, 4B)

(2) Demand that the space program be pragmatic and output oriented (1A, 2A, 5A, 1B, 10B)

(3) Need to concentrate on terrestrial needs (4A, 5B)

2) Second-Order Probabilities

Second-order opportunities and restraints are those that appear two or more times in one future only. The program planner who can sense trends, and hopefully has use of a dynamic methodology, can determine the greater probability of one or another future and can recognize those second-order opportunities of high probability, to construct a viable program. As stated above, however, second-order restraints need to be treated, even if this cognition does not exist.

a) Second-Order Opportunities

The second-order opportunities are:

(1) The need to respond only to a more limited group of decisionmakers (3A, 8A)

(2) Assurance of continued support (3A, 5A)

(3) Reliance on the technological fix (2A, 4A, 7A)

(4) The space program as a substitute for the arms race (the long sought "moral equivalent of war") (1B, 3B)

(5) The romantic appeal of space flight (2B, 8B)

(6) Broad-based support (3B, 5B)

(7) View of NASA as a service organization (6B, 7B)

b) Second-Order Restraints

The second-order restraints are:

(1) Space program viewed as a high-cost, high-risk investment (4A, 7A)

(2) Short public attention span will demand series of spectacular and instant results (2B, 3B)

(3) NASA will have to respond to many constituencies making a wide variety of demands (3B, 5B, 8B)

(4) High concentration of resources in any one program, such as space, will not be supported (4B, 7B)

(5) Need for continuous rejustification in light of changing terrestrial demands (6B, 10B).

3) Third-Order Probabilities

While any single opportunity or restraint may be important, the fact that third-order opportunities and restraints are by definition unique, there is no need to review them here. Once again, however, it must be noted that this analysis is not all-inclusive, and that use of this methodology by planners and their staffs should refine the analysis. In the continuing analysis of emerging futures, it is probable that some critical third-order opportunities or restraints will emerge which could establish them in new categories of second-or first-order. It is just as probable that the first and second order opportunities and restraints could be downgraded or deleted.

d. Use of Alternative Futures Methodology

Two alternative futures--Post Industrial I and Post Industrial II have been discussed in this appendix along with an analysis of certain of their features as they may affect the way in which NASA program planners go about their task. The study on the "Development of Methodologies and Procedures for Identifying Space Transportation System Payload Uses and Users" makes clear that the futures analysis provides only one dimension* of an overall methodology for a planning space program which will produce more effective, harmonious, and mutually beneficial relationships between NASA and other demestic governmental agencies. The main text of this report discusses the derivation, design, and use of the overall methodology. This appendix only supplements the discussion on the alternate futures dimension.

The value of the two futures described and analyzed here lies, not only in their specific content, but in the method of development. The

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* The other two critical dimensions of the overall methodology are the input data and analysis dimensions.

process through which they were derived is presented in the following paragraphs.

The process involves a sequence of steps that users of the system will have to retrace periodically. While the sequence is structurally logical, it is not, as has been stated above, a wholly objective process; subjective, judgemental, and intuitive elements play an important part, and the process does not guarantee completeness. No futures methodology, regardless of the number of computer runs, cross checks, or inputs can assure consideration of all factors. The process is repetitive and accretive. The user of any methodology with a futures dimension must continually evaluate the results against both actuality and his own assessment of the significance of new indicators. While this system is not infallible, it is far superior to the "crystal ball" approach to planning for the future.

In a practical sense, then, this means that the development of the methodology in this study is not a one-time event that provides an ever-reliable guide. Rather, it is the first step of a iterative process for probing the future, learning from each probe, and planning in response to that learning.* The alternative futures methodology involves the following five stages of continuing activity each of which is discussed in the following paragraphs: (1) probing the future, (2) content analysis, (3) defining strategies based on the results, (4) reality monitoring, and (5) modification of strategies. The preceding portion of Section 3 of this appendix has actually been composed of a detailed discussion of the specifics involved in performing these five steps. The following discussion is a terse description of what was being done.

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* Donald N. Michael, On Learning to Plan and Planning to Learn (Jossey-Bass, San Francisco, 1973), develops the concepts of futures-responsive-societal-learning (frsl) and long-range-societal-planning (lrsp) as a linked pair. Essentially, this idea is that learning must precede planning. We can learn about the future, but there is a separate but connected process of planning for it.

1) Probing the Future

This stage begins by identifying one or more comprehensive definitions of distinct alternative futures, generally a narrative description of a possible state of affairs in a given society at some future time. Usually, the time is fifteen or more years from the present. In the case of this study, two probable alternative futures were drawn from existing futures research in progress at Stanford Research Institute, Center for the Study of Social Policy. These futures essentially are updated versions of two alternative futures derived by the Field Anomaly Relaxation Technique (FARM). They were selected because of their large probability and their usefulness for illustrating this methodology. Both futures (or slightly different variants thereof) appear consistently in futures literature, but both are essentially normative. Had the study dealt with some of the less desirable or undesirable futures, the opportunity-restraint ratios and probabilities might have been very different.

After identifying the alternative futures, all characteristics distinguishing one future from another must be identified. By limiting this study to only two futures, each was analyzed in greater depth than otherwise would have been possible. For this study ten primary characteristics were identified for each of the Post-Industrial I and Post-Industrial II futures.

2) Content Analysis

By pairing the primary value characteristics as contrasts (provided that in no case is the contrast absolute), a set of issues which can be monitored emerge. The resolution of these issues determines the societal trend. For example, apropos of the futures illustrated in this appendix, if societal behavior supported frugality rather than consumption, the likelihood of Post-Industrial II future was enhanced. Most of the information available for monitoring will be cast in terms of such issues.

From each characteristic, a set of opportunities relevant to the space program, should that characteristic come to be general in the society, were identified. From the same characteristics, sets of restraints were derived in the same manner. It should be noted that not all characteristics of a future will result in the presentation of either restraints or opportunities.

The last step in content analysis is to sort opportunities and restraints by conditional probability. This results in ordering the probabilities. In this study, a "first-order" designation resulted when an opportunity or restraint could be derived from characteristics of both alternatives. A "second-order" designation indicated that more than one opportunity or restraint could be derived from characteristics of one alternative only. The final category, "third-order," included all other opportunities or restraints regardless of what qualitative value might be assigned to them.

3) Strategies

Concentrating on first-order opportunities, since these will be to some degree manifest in the transition period, the planner selects programs that will be, to the greatest degree possible, responsive to those opportunities while concomitantly assuring responsiveness to restraints of all three orders. He seeks support from those agencies whose opportunities and restraints complement his own.

4) Reality Monitoring

Space program liaison personnel working with other government agencies are, essentially, the implementors of the strategies derived in 3 above. An important part of their task is the gathering of trend information related to the futures; the planning strategies are based on the trend information. Their reports are basic to the content analysis. The results of this step are used as input to step 5 below.

One simple device for tracking a set of indicators is the contrasting pairs list of Table A-1. If any of the issues identified in the content analysis appear to be resolving a favor of one or the other of the characteristics assigned to an alternative future, or for that matter,

in a manner negative to both, the probability of either future can be determined more closely.

5) Strategy Modification

This step involves the modification of the strategies devised in step 3 above to reflect revised estimates of the situation. For example, if reality monitoring provides input that resolution in favor of a specific future is underway, the strategy should be modified to allow for the utilization of appropriate second-order opportunities.

5. SUMMARY

The preceding pages have been intended to demonstrate the manner in which alternative futures forecasting could be used by NASA to assist in its program planning process. Indeed, it has been urged that NASA can derive significant advantages from including a methodological, systematic futures dimension in its planning.

In so urging, SRI has been careful to imply, and wants to restate here, that the use of futures forecasting techniques will not guarantee either perfectly accurate descriptions of any future state nor ensure successful plans. However, by forcing the consideration of possibilities in a careful and disciplined fashion, and by establishing a permanent and responsive capability within the planning system for the necessary continuous updating of estimates of trends and their significance, the chances of egregious miscalculation are reduced.

A point not yet discussed is the extent to which other major actors on the national and international stage--government and intergovernmental agencies, corporations, foundations--are engaging in, or seriously considering, the results of applied futures studies. The emergence of a network of applied futures forecasters/planners working toward a common goal from different perspectives will provide a means of crosschecking that will enhance the value of any one agency's (for example, NASA's) forecasts and will, in addition, reinforce and enrich the capacities of them all.

APPENDIX A

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APPENDIX B

DETERMINATION OF THE NATURE OF A VIABLE NASA/USER INTERFACE

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Appendix B

DETERMINATION OF THE NATURE OF A VIABLE NASA/USER INTERFACE

1. INTRODUCTION

Nine meetings were held in January and February of 1974 to determine the essential characteristics of a viable interface between NASA and potential STS users within the domestic government. Relative to the methodology for identifying new users and uses for the STS, this interface must maintain an open, two-way communication link between NASA and potential government users that satisfies the following two primary objectives of NASA: (1) determining the needs, goals, and priorities of potential government users, and (2) identifying and/or developing the interest of these groups in potential STS uses. These two objectives have been identified as requirements of an effective interface.

Of the nine meetings held, seven were held with government agencies, a small but representative sampling of potential governmental users. One meeting was with the staff of a U.S. Senate committee, and one was with a representative of the American Gas Association. These two organizations were selected because this Senate committee has had experience in assessing the importance and relevance of potential solutions to problems of government agencies; and the American Gas Association is experienced in interacting with government agencies for the purposes of identifying and developing interest and support for programs of relevance to it.

Section 2 of this appendix contains a brief summary of each of these nine meetings. The general conclusions and observations that can be drawn from this information are given in Section 3.

Section 2 paraphrases the contents of the meetings in a question-and-answer format. Although a portion of each meeting did take this form, it should not be concluded that the entire meeting was this formal. Without exception, each meeting involved a two-way exchange of information in a relaxed, informal atmosphere in which the participants candidly asked

questions, answered questions, and made general comments pertinent to the subject. The format has been chosen primarily to paraphrase the information in a terse manner while simultaneously describing the immediate context in which the data was given.

The candor shown by the meeting participants will become evident to the reader as he reads the paraphrased summaries below. This forthrightness on the part of those contacted was necessary to the determination of substantive issues. It is the opinion of the SRI interviewers, however, that such candor might not have been shown if NASA personnel had been present; nor is it obvious that the people contacted would have been as frank in their comments had they been required to put them in writing. In order to honor the, at least tacit, spirit of confidentiality of these contacts, the authors have decided to grant a degree of anonymity to the interviewees. Thus, although the offices contacted have been identified to some extent, the people involved have not been identified. This step would not be necessary had SRI submitted the summary text of each interview summary to the interviewees involved for their approval prior to publication. Such a submission was not made, however, because it was felt that the approved manuscript might well be stripped of many of the substantive points brought out; hence, it was decided to protect the identity of those individuals who took the trouble and time to provide SRI with the information paraphrased below.

2. DETAILS OF MEETINGS

a. General Information

The nine agencies contacted were:

(1) Department of Commerce--Bureau of the Census

(2) Department of the Interior--Office of Coal Research

(3) Department of the Interior--United States Geological Survey

(4) Department of Transportation--National Highway Safety Administration

(5) Department of Transportation--Office of Systems Development and Technology

(6) Department of Agriculture--Soil Conservation Service

(7) Environmental Protection Agency

(8) A United States Senate Committee

(9) American Gas Association

The meetings with these nine agencies were held January 14-16, 1974 and February 13-15, 1974 in and around Washington, D.C. The following SRI personnel were involved in these meetings:

(1) Dr. Nicholas A. Beauchamp, SRI-Huntsville

(2) Dr. David C. MacMichael, SRI-Menlo Park

(3) Mr. Harold E. Bertrand, SRI-Washington

(4) Mr. Joseph G. Rubenson, SRI-Washington

b. Meetings Held

1) Department of Commerce--Bureau of the Census

a) Date--January 15, 1974

b) Location of Meeting--Suitland, Maryland

c) SRI Personnel Present

1. Dr. Beauchamp

2. Mr. Bertrand

3. Dr. MacMichael

d) Length of Meeting--1.5 Hours

e) Summary of Meeting*

Q: Are you aware of the capabilities of NASA?

A: We are aware of at least a few of them. In fact, we are doing some analysis of ERTS data. However, we are not sure we have sufficient knowledge of all NASA capabilities. Apparently, we know pretty well the existing capabilities but do not know much about future capabilities.

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* The question (Q) and answer (A) format is used throughout this section with SRI in the role of interrogator. The reader should remember that the information given is a paraphrase of the actual meeting content.

Q: Is there formal documentation on your long-range plans, goals, needs, and priorities?

A: We have plans which we have generated internally. We are probably one of the few government agencies that does have plans in such a formal form; but this is possibly due in part to the fact that we know that every ten years we have a large census job in front of us. Right now, one of the largest jobs we are planning is the "Ideal Census" for the year 2000. Mr. Barabba is acting as project manager for this effort which right now is at the stage of attempting a definition of what we would like to be able to count and the questions we would like to obtain answers to, regardless of the technical limitations we might be faced with. Eventually, of course, the technical limitations will have to be imposed. Perhaps NASA can help us to define what those limits are.

Q: Who would be the point of contact in determining more about what your interests and needs are?

A: The initial point of contact might well be the Director, Mr. Barabba. As the discussion became more specific, it should probably be directed toward one of the Field Directors, an Associate Director, or a Deputy Associate Director. The logical approach to take, should the interaction between NASA and the Bureau become rather significant in magnitude, would be for us to appoint a single individual who would attend NASA capability briefings and then interface with the NASA representative on specific points as needed. We would expect that an effective interaction would require our man to become somewhat familiar with your (NASA's) capabilities and for your man to become at least somewhat knowledgeable in our problems. In any event, these interactions should probably be more organized than in the past; and, for NASA's part, should stress technology less and put more emphasis on what its capabilities can do for us. In addition, let me say that talking about STS only does not necessarily make sense to us. If we are looking for the best way to solve a problem, it does not matter whether it is STS, Skylab, or a dedicated satellite that is the source of data. What we are looking for is, for those cases where there exist several alternatives for obtaining the same data, the cheapest, most reliable way of getting it. If a space-based system is the way to get it, then fine. But it must be realized that cost is a very important factor.

Q: Then cost comparison is an important factor?

A: Yes, but of course only on those items for which there exist alternate ways of getting the same information. It should be recognized that space-based sensors may be the only way to get certain information, however. For example, some of the information we are contemplating for collection in the census of the year 2000 may not be obtainable directly because of the reticence of people to answer certain types of questions.* Under these circumstances, any reasonable cost for a space-based, data-gathering capability would probably be supportable.

Q: What other types of input would be necessary before you felt that you could make a decision to use a NASA capability?

A: In general, we would probably have requirements on orbit, the coverage of the sensor. In addition, we would want to know the reliability we could expect. And, what priority could we expect? We have to be able to count on the availability of the sensor. Therefore, a related problem we would need to address is that of scheduling. Another item we would want to address is that of the lead-time required. If we can't obtain sufficient lead-time, we will have to make other arrangements to get the data. And if too large a lead-time is needed for NASA to put together the payload, we may not be able to define our needs in time.

Q: Are there any developments beyond those currently available to you that you now see as having some potential utility for you?

A: Yes. The resolution on the ERTS imagery is not sufficient for many of our needs. Some of the imagery from Skylab showed that improved resolution could be of great help. But its coverage is not complete. I am sure there are others that we could think of; but our feeling is that there are probably many data available from space-based imagery analysis that are unknown at this time for which we would have use. To uncover these would take a close working relationship between us and NASA, for us to learn more of what can be done and for NASA to learn more of what we would

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* The existence of this attitude was alluded to in the discussion of value characteristic 9B of the Post-Industrial II future in Appendix A.

like to be able to measure. And let me repeat what I have said earlier: NASA should stress what its technology can do for us, not the technology itself.

2) Department of the Interior--Office of Coal Research

a) Date--January 16, 1974

b) Location of Meeting--2100 M Street, N.W.
Washington, D.C.

c) SRI Personnel Present

1. Dr. Beauchamp

2. Dr. MacMichael

d) Length of Meeting--1.0 Hour

e) Summary of Meeting*

Q: Do you have any long-range plans for meeting your organizational goals? What are your priorities as you see them?

A: You caught us at a bad time. No, we really don't have any long-range programs set up. The world is a different place since October of 1973 (date of Arab embargo). We are still adjusting to that. We do see, in general terms, a need for resource exploration and monitoring as part of our overall charter for developing the use of coal.

Q: The task of research exploration monitoring is, of course, appropriate for a potential STS mission. Are there any comments you have to make about the use of NASA capabilities, in spite of the fact that your long-range programs are not yet formalized?

A: Yes. And you should realize that we hope to have our plans formulated to some degree of detail by a year or so from now so that this question might be answered more definitively at that time. But back to the present. Regarding space-based imagery which can be used for resource monitoring, we do see a use for this capability. However, the resolution available on ERTS (90 meters !) is much too

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* The question (Q) and answer (A) format is used throughout this section with SRI in the role of interrogator. The reader should remember that the information given is a <u>paraphrase</u> of the actual meeting content.

small for our purposes. Additionally, we see a need to have imagery for viewing angles well away from the near-normal of 90° that characterizes most of the ERTS data. But I would like to say that it is not only the space-based imagery for which we see a possible use of NASA's capabilities. For example, NASA has done quite a bit of work in the area of heat transfer and has investigated engines which use methanol and other fuels. Inasmuch that methanol and other compounds are available from coal for use as fuels to replace petroleum-based fuels, we would like to make use of what NASA has learned in the two areas mentioned.

Q: It seems that you are somewhat aware of NASA's capabilities. Is this the case elsewhere within the Office?

A: Probably not to as large an extent as it is with me, since I used to be with NASA. But that is not to say that there is not a general awareness of what NASA has to offer. In this light, let me make the following observations. There is within this Office, and in other Offices within the government, the feeling that NASA has spent an awful lot of money for the return it has obtained; although it is readily admitted that a return has been obtained. In connection with this, there is the feeling that NASA has in the past enjoyed the position of a "fair-haired boy." It may be that I am more sensitive about this than most; but, I am convinced of the existence of this attitude. It is the general feeling among these people that this situation is changing and that NASA will have to enter the "real world" inhabited by the rest of the government agencies. In particular, they feel that this means that NASA will have to justify any program on the basis of its costs and benefits. I feel that this is a fair way to go. In this office, for example, we have a limited budget and any interface with NASA on a potential use of NASA capabilities will be made because NASA has the most to offer for a given investment of our funds.

Q: In attempting to establish a working relationship between you and NASA in developing potential uses of the STS or any other NASA capability, how should the dialog be initiated?

A: First, involve the high-level policy-making personnel on our end in the process. Any such discussions would probably begin with a rather general

discussion of NASA's plans and our goals and priorities. As specific potential uses of NASA tools become identified, the appropriate people in our office would be called in. It would be wise for NASA to discuss not only the STS in these interactions, but also its other capabilities. In addition, it would be extremely useful in our discussions to address the relative costs of using various approaches, including aircraft photography.

3) Department of the Interior--United States Geological Survey

a) Date--January 16, 1974

b) Location of Meeting--1925 East Newton Square
Reston, Virginia

c) SRI Personnel Present

1. Dr. MacMichael

2. Mr. Bertrand

d) Length of Meeting--1.0 Hour

e) Summary of Meeting*

Q: You have past experience in interacting with NASA in the use of NASA capabilities. Do you see a need for continued use of similar capabilities?

A: Yes. In fact, our future needs for data from space-based sensors may well increase in the future. For example, there is a new regulation that requires states to have their own land-use programs in order to qualify for certain Federal monies. The implementation of these programs will certainly create an increased demand for land-use data from the states. We believe strongly that benefits could be derived from expanded use of sortie missions and that the Manned Space Shuttle should be classified as an experiment, thus enabling greater dissemination of data to independent researchers in the same manner that ERTS data are handled.

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* The question (Q) and answer (A) format is used throughout this section with SRI in the role of interrogator. The reader should remember that the information given is a paraphrase of the actual meeting content.

Q: In view of your past experience in working with NASA, what do you see as an appropriate way for NASA to interact with you in the development of new uses of NASA capabilities?

A: First, I would recommend that heavy users of NASA capabilities have a liaison individual in NASA. The presence of a single point of contact would greatly enhance the efficiency of the information exchange between NASA and us. Second, I would recommend that NASA permit or encourage dialogue between us and the contractor who puts together the payload. The absence of this opportunity has been the cause of some grief in the past. For example, on Skylab, NASA asked us our needs for Skylab. We responded and NASA began the process of getting hardware together to satisfy our need. Well, the procedure did not work: the payload as put together did not satisfy our needs. There were several reasons for this, all of which could have been avoided if there had been a close working relationship between us and the contractor. The underlying reasons for the Skylab problem were that we were not able to specify our requirements to any great degree of detail when asked and that NASA and the contractor did not realize that seemingly minor engineering changes to the payload can have a great impact on the relevance of that payload to our needs. As I said, both of these problems could have been worked around if we had been in close contact with the contractor. But don't get me wrong: we do not want to define equipment specifications. We still view that as properly a function for NASA and the payload contractor.

Q: When would you be willing to start talking to NASA about the potential use of STS to meet some of your needs?

A: Now. But we would like to get into questions of cost, reliability, and flexibility very early in such mutual exploration of potential STS uses. One of our primary concerns is whether or not we could reschedule a launch or post-launch failure and still meet our original objective.

4) Department of Transportation--National Highway Safety Administration

a) Date--January 15, 1974

b) Location of Meeting--2nd and V Streets, S.W.
Washington, D.C.

c) SRI Personnel Present

1. Dr. Beauchamp

2. Dr. MacMichael

d) Length of Meeting--1.5 Hours

e) Summary of Meeting*

Q: Although NASA and the Department of Transportation (DOT) have had several occasions to interact in the past, I am not aware of significant interactions with your particular Administration. Are you speaking primarily from the experience of your own Administration or from the experience of DOT as a whole?

A: The National Highway Safety Administration has not had a lot of interaction with NASA, and we are not sure that a lot of potential exists for the use of NASA capabilities in our work, although we would be glad to talk with NASA about this. Therefore, most of my comments will be offered with me in the role of a DOT representative rather than a member of just this Administration.

Q: Has any thought been given to the possible use of NASA capabilities, particularly the STS, in future DOT work?

A: Yes. Several potential uses of NASA capabilities have been brought up. For example, the Coast Guard has brought up the possibility of using space-based sensors to support their activities in search and rescue missions, buoy maintenance, and ship navigation.

Q: With this knowledge at your finger tips, it would appear that a lot of information flows between different Administration offices within the DOT. Is this the case?

A: No, not really. This cross-talk occurs only in joint programs, for the most part.

Q: Under these circumstances, what is the appropriate way for NASA to interface with the DOT? With the individual Administrations or with some single office within the DOT?

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* The question (Q) and answer (A) format is used throughout this section with SRI in the role of interrogator. The reader should remember that the information given is a <u>paraphrase</u> of the actual meeting content.

A: The proper place for NASA to enter the DOT is at a high level: either at the Assistant Secretary's level or at the level of the individual Administrators. In retrospect, the Assistant Secretary's level would be appropriate for two reasons. First, it affords an opportunity to coordinate the overall activities. Second, it presents the best opportunity to repair the damage that past DOT/NASA interactions have caused. Let me expand on that. There is a negative attitude toward NASA by quite a few of the DOT personnel, and some of these are in rather high places. For example, the CARD (Civilian Aviation Research and Development) program has been a joint NASA and DOT effort on which NASA was to provide program definition. The effort has gone on for years without much apparent progress being made; and DOT has had the feeling that NASA wants to usurp much of the responsibility that is rightly DOT's. Another example is that of the PRT (Personal Rapid Transit) study. The cost and complexity of the NASA solution to the problem was felt to be completely unrealistic for real-world implementation. There was also the feeling that NASA would, if the program were allowed to continue, end up trying to run the whole show. I guess you could say that people got nervous about the NASA participation. Now, although the PRT effort was done only for UMTA, and in spite of I said earlier about the lack of cross talk between Administrations, the reluctance to work with NASA has spread to other parts of DOT. In addition to the feelings that have been generated by the less-than-resoundingly-successful interactions referred to above, there is a general resentment of NASA among the DOT personnel because of what is viewed as a past favorable treatment of NASA in its budgetary requests. There are some, for instance, who say "Sure, NASA put a man on the moon; but who couldn't have, given that much money?" The existence of this attitude means that NASA will have to show the real-world applicability in very clear terms, both as regards technical complexity and costs, for any potential use of its capabilities in support of DOT needs.

Q: What approach should then be used in NASA's opening a dialogue with DOT?

A: As I have said, the interaction should be undertaken at a high level within DOT. And this necessarily means that the NASA personnel involved in this interaction must enjoy a high position within the organizational chart of NASA. It is recommended

that these people be from Headquarters NASA. As regards the content of these contacts, let me first state that we at DOT recognize that NASA has a valid mission of its own. It, therefore, flies payloads of importance to it. This activity is appropriate; but NASA's conversations with us should not consist of a justification of NASA's programs. The interaction of NASA with the high-level DOT personnel, therefore, should stress only applications of utility to DOT in its efforts to do its job. In this light, it is suggested that the contact with the high-level, policy-making DOT offices be made with specific applications in mind for future NASA/DOT joint programs. For example, one might bring up the potential uses mentioned earlier for the Coast Guard, or the use of space-based systems for aiding the Federal Aviation Administration in furnishing navigation services, or any other specific use. But in any interaction, NASA should stress the fact that it is discussing a potential use in support of DOT, and the division of responsibilities in any potential joint endeavor should be clearly spelled out early in the discussions to avoid any future repetition of the situation that occurred in the PRT effort.

Q: Does there exist documentation on the long-range plans of DOT which would be of assistance in NASA's preparation for this high-level interaction?

A: Not in any single document. And in fact, much of it may not exist in documented form. There is a current attempt to formulate a 20-year plan for DOT. The individual Administrations are being requested to contribute to this plan. However, I do not believe that much suffess has yet been achieved in putting an integrated plan together. Each agency is still trying to put its own program together.

5) Department of Transportation--Office of Systems Development and Technology

a) Date--February 13, 1974

b) Location of Meeting--Phone Conversation

c) SRI Contact--Dr. Beauchamp

d) Length of Conversation--45 Minutes

e) Summary of Conversation*

Q: What is the appropriate point of contact within the Department of Transportation for the determination of the long-range goals, plans, and priorities of your Department?

A: This office. Mr. R. H. Cannon, the Assistant Secretary for Systems Development and Technology, heads up this office with a good-sized staff under him. This is the only office where long-range planning is really considered due to the fact that the various administrations (UMTA, FHA, etc.) are too tied up with the problems in the operational area to think much beyond about two or three years into the future. Jerry Ward, under Cannon, is head of R&D Policy and is probably the best single contact on our long-range plans.

Q: In NASA's efforts to identify new uses for the STS, what would be the nature of an effective interface with your Department?

A: We have had some past experience in interfacing with NASA and I believe that I can answer that from a base of some experience. First, let me note that some of the past interaction with NASA has been far from ideal as far as we are concerned. For example, we felf that NASA was attempting to usurp our authority in its efforts on PRT (Personal Rapid Transit). We were anticipating support from NASA and got what we felt to be an attempt on the part of NASA to run the show. In addition, the suggestions that came from NASA on this effort were viewed by us as being unrealistic and somewhat unresponsive. In particular, the system which NASA came up with was too expensive for implementation by local governments and was too complex for successful operation by the personnel who would be assigned to it. However, this and other similar cases should not preclude the possibility of amicable and useful future interactions as long as NASA does not usurp the authority which rightfully belongs within the Department of Transportation and as long as the proposed uses of NASA capabilities are responsive to the actual needs. One contributing factor for this optimistic outlook must, realistically, be assigned to the fact that

* The question (Q) and answer (A) format is used throughout this section with SRI in the role of interrogator. The reader should remember that the information given is a <u>paraphrase</u> of the actual meeting content.

there has been a change in the DOT administrators involved with the past bad experiences with NASA.

Q: In connection with the planning activities that are underway in the Office of Development and Technology, are there any potential uses of NASA capabilities that have been identified?

A: Yes, although it should be pointed out that formal documentation of our plans has not been issued. Among those potential uses of NASA capabilities that have been mentioned are: air traffic control from satellite; the monitoring of oil spills from space; aids to navigation from space; assistance in search and rescue missions; and ground traffic monitoring. A study is currently going on at Westinghouse to determine appropriate satellite uses for the Coast Guard. It should be noted that some of the proposed uses would call for continuous coverage with real-time readout capability. This is a departure from current capabilities.

Q: Are there any more general observations you would like to make with regard to the desired nature of a NASA interface with the Department of Transportation?

A: A few. Let me summarize my feelings by first reiterating some of the points I have already made. First, the image which should be projected and lived up to by NASA is that of a supporting organization which has a set of capabilities which it is willing to adapt for the solution of some of our problems. But, in the interface, NASA should leave the final determination of our needs up to us. Second, we already have a general appreciation of the tools which NASA can bring to bear on our problems and we have already identified a few potential uses of these. However, in order for any of these potential uses to result in an actual program, it must be shown to be cost-effective. Third, we recognize the inadequacy of some of the current NASA capabilities to serve some of our needs. For example, the ERTS imagery resolution is insufficient for some of our needs. Fourth, personal contact between us and NASA will be needed in order to give NASA an appreciation of our needs, goals, and priorities: they do not exist in formally documented form. Fifth, we are ready to have discussions with NASA concerning the use of their capabilities at any time. In fact, we have such talks going on at this time.

A somewhat more organized approach might well be valuable, however. And it is suggested that the STS not send its own representative to interface with us to the exclusion of the other NASA capabilities. We wish to be able to interface with the agency as a whole.

6) Department of Agriculture--Soil Conservation Service

a) Date--February 14, 1974

b) Location of Meeting--14th Street and Independence Avenue, S.W., Washington, D.C.

c) SRI Person Present--Dr. Beauchamp

d) Length of Meeting--1.5 Hours

e) Summary of Meeting*

Q: I note that you are associated with the Soil Conservation Service. Are your comments based only on your experience in this branch or do they draw on a broader base of experiences and outlook?

A: My comments are based on my experience in this and other branches. My outlook, therefore, is broader than just that of the Soil Conservation Service.

Q: Does the Department of Agriculture have an explicit effort underway to investigate the uses of space for its purposes?

A: Yes. This is partially in response to some criticism directed our way on not making full use of the information available to us from existing programs such as ERTS. An existing task force is addressing ERTS technology. We hope to be able to identify what this technology can provide us, the cost involved, and the time frames in which specific returns can be expected. In addition, we are to make specific suggestions about what the Department should do about realizing the potential benefits from ERTS. The job we are doing is performing for ERTS technology what a standing committee is supposed to do for other capabilities over the long term. This committee, called the Earth Resources Survey Committee (the

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* The question (Q) and answer (A) format is used throughout this section with SRI in the role of interrogator. The reader should remember that the information given is a paraphrase of the actual meeting content.

ERS Committee), will essentially take over where this task force leaves off when the task force is disbanded in a few months.

Q: It appears that you have gone through some of the same operations that will be necessary on the part of NASA to identify new users and uses for the STS. Which of your findings do you think have validity to NASA in its STS user and use identification program?

A: First, of course, it will be necessary to identify the needs of the potential user. Next, there is the need to know exactly what capabilities exist which might go at least part way in meeting that need. And where existing capabilities don't exist to meet the needs identified, it should be explicitly stated. NASA then has the option to undertake a program which would provide the required capabilities or to forget it. But in either case, the potential user should be informed of the decision so that he can plan to satisfy his need via an alternate route. For example, we already have concluded that the existing ERTS imagery resolution is not sufficient for some of our needs. We would like to discuss with NASA the chances for obtaining better resolution on future missions so that we can go ahead and plan our own internal programs either to take advantage of these data when they become available or to make other arrangements to obtain the information we need.

Q: Where is the appropriate point of contact with the Department of Agriculture for the continuing interaction that you see required in this area?

A: The ERS Committee is the proper point of contact. In particular, the Chairman of that committee, Myles Howlett, is the right man for the initial contact although the Steering Committee of the ERS Committee will probably prove to be the right spot for the long-term interaction. This interaction is, as you might guess, is at the policy or management level within the Department. Past interactions with NASA have not been at this level; rather, they have been primarily at the technical level. This approach has been the source of a great amount of unhappiness with regard to the interactions with NASA.

Q: Why?

A: Let me see if I can explain it to you. As I have said, NASA has apparently preferred to work with

technical people in the field. Perhaps this is understandable; our technical field personnel probably talk nearly the same language as do the NASA personnel. For example, at this time there are two employees of the Forest Service who are spending a lot of their time at Johnson Space Center to determine what use might be made of data from space-based sensors on the forest land of Texas. Now, what happens if their investigations show that one can obtain data from space which ordinarily would be gotten from rangers in the Texas forests? If it is to be more than an idly interesting piece of information, this finding should result in a different way for the Forest Service to do its job in Texas. But the decision to change the way a job is done involves a policy decision on the part of management. Funds and manpower have to be reallocated in order to support this move. The people who make these decisions are here in Washington, not in Texas. I do not think that these people are being at all unreasonable when they insist that any program that has a potential impact at the policy level should be first cleared at that level. And that is what we at the Department of Agriculture would insist on. I believe that you will find that any government agency will feel the same way: start your discussions of potential uses of NASA capabilities at the policy-making level.

Q: Your comments stress the use of NASA's capabilities in the day-to-day operations of your Department. Surely, there are research and development uses which would not require the presence of such high-level personnel in the loop until these programs developed promising results.

A: Let us look at a typical government agency. It is set up with certain responsibilities and develops a set of operational programs for its day-to-day activities to meet these responsibilities. Most of its funds are taken up with these operational activities, probably more than 70% for a typical government organization. The research and development activities probably account for less than 10% and 20% of its budget, respectively. And any activities undertaken in the research and/or development side of the house are undertaken because of their relevance to the day-to-day operations. That is to say, a project is funded in the research and development area only if it appears that the effort will result in better and/or cheaper ways to perform an

ongoing operational activity or if it allows the agency to perform a job within its charter that was not previously possible. When viewed in this light, I think it is clear that any potential use of NASA capabilities should appropriately involve the user agency's management from the outset of discussions.

Q: From this discussion, I gather that you view research and development in a government agency as something which is undertaken only after its general feasibility has been shown. This is somewhat different from the usual definition of the terms. Do you wish to comment on this?

A: Yes. You are quite right. We use the term research, in particular in a different sense from the way that NASA uses it. Our "research and development" probably falls completely under what NASA would call development. We are never in the position of "tweaking the knobs" just to see what happens, as one might do in the research phase of a NASA program. Our "research and development" steps, therefore, are essentially two somewhat distinct phases between what NASA calls research and the operational phase.

Q: How important is the cost of a potential use of the STS or other NASA capability?

A: Extremely important. And by cost, I do not mean only that cost which is directly billed to the user. The cost that must be considered in evaluating the utility of a specific use of the STS or any other NASA capability should include the costs to NASA.*

Q: From where you sit now, do you feel that there is a strong potential for identifying STS uses of value to you?

A: From what I know now, the answer is in the affirmative. A detailed analysis of each potential use will have to be made, of course. Our work to date has already shown us that existing capabilities are

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* This is the only meeting which uncovered this observation, which is, in the language of Appendix A of this report, a typical Post-Industrial II value. It is important that attitudes like this be monitored. The emergence of this attitude as a dominant one would call for at least a moderate, if not a major, change in the way that NASA figures costs in the methodology described in this report.

not sufficient for some of our needs. I have already mentioned the fact that we would like to see improved resolution on ERTS-like data. Additionally, we can already see the need for continuous coverage with essentially real-time readout. The delay in the delivery of ERTS imagery data to us is hampering a lot of its potential utility. We recognize that providing high-resolution, continous coverage with real-time readout capability will be expensive. Perhaps we could team with several users to field such a capability. But we would be looking to NASA, not to our own people, to determine if this could be done. Thus, in direct answer to your question, we do feel that there is a strong potential for use of NASA space-based capabilities in our work. In closing, let me make two further observations. We would want to be involved in the evaluation process for any proposals that NASA puts out for bid in connection with an effort undertaken to satisfy our needs. Since we are the ones who are most familiar with our needs, we want to assure ourselves that these needs are not being compromised somewhere along the way. Lastly, it is not clear that the biggest question facing us concerning the utility of sensor data is that of the sensor's characteristics. It may well be the development of the software to make optimal use of the data returned. I would like to make a recommendation that NASA not lose sight of this aspect of the use of STS or any other system.

7) Environmental Protection Agency

a) Data--February 15, 1974

b) Location of Meeting--Waterside Mall, Washington, D.C.

c) SRI Personnel Present

1. Dr. Beauchamp

2. Mr. Rubenson

d) Length of Meeting--1.0 Hour

e) Summary of Meeting*

* The question (Q) and answer (A) format is used throughout this section with SRI in the role of interrogator. The reader should remember that the information given is a paraphrase of the actual meeting content.

Q: You already have an existing interface with NASA. How formal is this interface?

A: There are several aspects to this relationship. For several years, there was only a working relationship between EPA and NASA technical personnel. Now, there is a formal agreement between EPA and NASA, and has been for about two years. The agreement was reached at a high level: between Fletcher of NASA and Ruckelshaus of EPA. It was reached rather amicably and essentially as a natural outgrowth of the existing technical working relationship. I must admit, however, that there was some congressional and legal pressure for us to use NASA capabilities. This pressure probably speeded up the process whereby we now have formal commitments to use NASA capabilities, but the situation would eventually have developed of its own accord.

Q: For the most part, your use of NASA's tools has been restricted to the use of monitoring capabilities. Where would be the proper point of contact for further interaction in investigating the use of new NASA monitoring programs for your purposes?

A: The appropriate point of contact for monitoring activities is the Assistant Administrator for Monitoring. There are several projects ongoing in this area already. I think that you will find that Mr. Koutsandreas has been acting as the main EPA liaison man with NASA on monitoring usage. On uses other than monitoring, Mr. Rolf Roberson is the proper point of contact. It should be realized, however, that there is probably only one office in EPA that is currently thinking as far ahead as the operational time frame of the STS, and that is the Research Office (Dr. Attaway). All the other offices have their hands full worrying about plans which extend only over the next few years. Incidentally, the operational programs which are underway to involve one or two interagency agreements with NASA. These are rather specific in contrast to the rather general one between Fletcher and Ruckelshaus.

Q: You use the word "operational programs". Is this term used in the same sense that I have just heard it used by a member of the Department of Agriculture? That is, is an "operational program" one that supports the performance of your day-to-day activities?

A: Yes. And as was the case at the Department of Agriculture, what we call "research and development" corresponds to what NASA calls "development". Our budget is largely set aside for operational programs.

Q: Have you formally set forth your needs for your future efforts? At least within the sensor monitoring area?

A: To some extent. We are currently using ERTS data, of course and will continue to do so. When looking at what NASA capabilities we might make use of, it is hard to break the Shuttle off by itself. Therefore, let me address space-based monitoring in a generic sense. We see a requirement for continuous coverage. In some uses, a real-time readout capability is required, but this is by no means universally true. In addition, we have found that the existing ERTS resolution does not provide the information we need. I believe these comments could serve as point of departure for future talks with NASA.

Q: What uses would you have for future monitoring activities?

A: We have listed our 16 leading problem areas. Any near-future potential use of the STS would probably result from our attempts to solve these problems. These problems are, not necessarily in decreasing order of importance:

1. Salinity control in agriculture
2. Water reuse in the West
3. Brown cloud over Denver
4. Agriculture runoff
5. Eutrophication
6. Strip mining
7. Pest infestation
8. Industrial outfalls
9. Everglades protection
10. Power plant thermal plumes
11. Oil spills
12. Acid mine drainage
13. Ocean dumping
14. Solid waste management
15. Sulfur dioxide from copper smelters
16. Sedimentation and algae productivity

Q: Are there any particular suggestions that you would like to make concerning future efforts to identify and develop NASA capabilities appropriate for your needs?

A: A few. First, we would like to be involved in the evaluation of the NASA-issued proposals for the payloads which are supposed to meet our needs. We have been involved in this step on ERTS-B and have found it to be an effective way to be sure that the payload flown will actually meet our needs. Second, please do not ask us to attend two-week meetings to learn what new things are available. We are pressed for time. An approach which permits NASA personnel to talk personally with our organization with regard to what its (NASA's) technology can do for us would be most appreciated. We are not interested in hearing the gory details of what the technology is; we are interested in what it can do--for us! Third, it would be valuable if NASA could put into perspective the relative benefits of a space-based sensor and one in an aircraft. We still do not have a full answer to the question of what an aircraft can do for us.

8) United States Senate Committee

a) Date--February 14, 1974

b) Location of Meeting--Senate Office Building
Washington, D.C.

c) SRI Personnel Present--Dr. Beauchamp

d) Length of Meeting-2.5 Hours

e) Summary of Meeting*

Q: We at SRI are in the process of developing a methodology for identifying new users and uses for the STS within the domestic government sector. I have had a series of meetings with various government agencies in an attempt to determine the nature of a viable and effective interface between NASA and these organizations as part of the overall methodology being developed. As a result of the meetings held to date, I have come to a set of conclusions. Could you comment on the general validity of these, as you view the situation? (A list of conclusions was shown to the members of the Committee. Their response and comments are summarized below.)

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* The question (Q) and answer (A) format is used throughout this section with SRI in the role of interrogator. The reader should remember that the information given is a paraphrase of the actual meeting content.

A: Our views agree pretty much with yours. Specifically, we believe that it will be absolutely essential for NASA to interact with potential governmental users of the STS (or any other NASA system) at a high, policy-making level. We will have more to say about this later. We also agree that NASA should project a supporting image akin to that of a service organization when approaching potential users. But it should not be forgotten that NASA has a role in its own right. We note that the technology transfer briefings came in for a bit of criticism, some explicit and some implicit, as not being the right way to get potential users aware of what NASA can offer them. True, a more personal interaction is needed. But these briefings and other methods that NASA has used in getting its capabilities before the non-NASA world must have done some good: look at how many groups have a pretty good idea of NASA's capabilities. Your point is well taken, however, that future NASA interactions should stress what NASA's capabilities can do for the user rather than the details of the technology which supports this capability. Your observation that the potential user considers cost of primary concern is not new nor is it surprising that almost every agency contacted brought it up. The comment that the potential users find the resolution of ERTS data insufficient for at least part of their needs is also not unexpected. The observation is probably true. However, it must be realized that the problem in obtaining improved resolution is not so much a technical one as it is a political one. We are currently talking with the intelligence community to get release from them for incorporating improved resolution equipment on board. But there still remains the problem of what do you do about, e.g., Brazil's complaint that high resolution constitutes a violation of privacy? This problem of resolution, therefore, may require years of work on the political scene before NASA can do much about upgrading the existing capability to any great extent. We are aware of the past problems with DOT and are glad to hear that it appears that some avenue of communication exists to establish a cordial, workable relationship.

Q: You said that you would come back to the need for a high-level contact between NASA and potential users of NASA capabilities. What did you wish to say about this?

A: The comments that you picked up from the Office of Systems Development and Technology in the Department of Transportation and from your contact in the Department of Agriculture are quite valid. This is the type of interaction which has been lacking in past interactions of NASA with other government agencies. For the purposes of your methodology (the identification of new users and uses for the STS with the government), we feel that we can characterize the type of person for this job. He is probably not in NASA now; or if he is, he is not doing what would be required of him in this high-level liaison activity. The type of person required for this job should have the following characteristics:

1. He should be between 35 and 50 years of age. Any younger, and he won't be able to gain the respect he needs to perform his job effectively; any older, and he probably won't be able to take the physical strain of the job.

2. He must have a good command of the English language as spoken by the people he is to contact.

3. He must be at least a technical buff of the type who at least subscribed to Popular Mechanics when he was a kid. His duties do not require him to be a technical man; he can call on other NASA personnel for this support. But he must know when and where to get them when he needs them.

4. For obvious reasons, he must be honest and his honesty must be apparent. Without this trait, his credibility with the potential user is lost and, with that loss, much of the utility of the high-level liaison work goes out the window.

5. He must be well-dressed, gregarious, personable, and capable of meeting with the policy makers as a peer both in and out of the office.

6. He must know what is going on at NASA--not only to aid in his efforts to develop interest in new uses of NASA capabilities, but also to enable him to maintain credibility with potential users. If a program is in trouble, he should know about it.

7. Since he will be interacting with people who are pressed for time, he must be sensitive to the feelings and thoughts of others in order to know when to leave a man's office.

8. He must be familiar with the problems and the vocabulary of the potential users with whom he interacts.

9. He must maintain contact with each of the potential clients assigned to him.

Several other attributes could be assigned to this high-level liaison individual; but they are all those of what might be called a super salesman, although it is clear that this is not what he should be called. One might consider calling him an Executive Assistant to the Administrator or something like that; but it is imperative that he be identified with the Office of the Administrator in order to enjoy peer status with some of the people he will be dealing with. The type of person we are talking about is one that tailors the exact approach he uses to the potential client. If he has sense enough to do all the things outlined above, however, he is not going to be cheap. NASA will have to pay for his services. A minimum of $36k a year would be my guess. Plus expenses. And a secretary. And a computer remote terminal if he wants it. In closing, let me say that probably the most significant and valid point that you have uncovered in your meetings with potential governmental users of the STS is the need for this high-level liaison activity.

9) American Gas Association

a) Date--January 14, 1974

b) Location of Meeting--Arlington, Virginia

c) SRI Personnel Present

1. Dr. Beauchamp

2. Dr. MacMichael

3. Mr. Bertrand

d) Length of Meeting--1.5 Hours

e) Summary of Meeting*

Q: Do you, as an organization, have any project underway with NASA?

A: No. We were approached back in 1970 to define our needs which could be met with the Earth Orbital Space Station. We replied to that request early in 1971 but never heard anything in reply.

Q: Did that experience sour you on future interaction with NASA?

A: Not at all. We figured that NASA had more important things to do* and did not have the resources to get around to following up on developing our participation. We would have liked to have pursued this development further, particularly at a more personal level; most of the interaction was either by letter or by attendance on our part at a NASA-sponsored meeting. We would be happy to open a dialogue with NASA at any time to identify and develop uses of the STS or any other NASA system of relevance to us.

Q: Do you actually fund research work of your own?

A: Yes; but we are one of the few industry associations that does so. Many of the others do not have research budgets of their own. Their approach is to: identify existing government-sponsored programs of relevance to them; attempt to shape these to best fit their needs; and to provide inputs to government agencies for undertaking new programs to meet the needs of these industry associations. As a matter of fact, let me suggest that NASA talk to these groups in an attempt to identify new uses of the STS. These organizations reflect a large segment of the domestic commercial sector whose needs will be reflected in government-sponsored programs. It may well be that NASA could utilize the influence of these groups in developing governmental interest in potential uses of the STS.

3. CONCLUSIONS AND OBSERVATIONS

As a result of the meetings summarized above, several conclusions were drawn as to the nature of an effective interface which will satisfy the

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* Note the second appearance of an explicit mention by a potential user of the importance of NASA's own internal goals. This point was referred to in Appendix A.

NASA requirements on gathering data on user needs and goals and on developing interest in potential uses of the STS. These are summarized in the following paragraphs.

a. Data-Gathering Activity

Interviews with various government agencies revealed that the long-range plans of most of the potential government users of the STS have not been documented. Even more to the point, it was found that the agency goals and priorities of interest in the operational time-frame of the STS are not well organized outside the minds of people in the policy-making offices of these agencies. Therefore, complete determination and monitoring of potential user goals, needs, and priorities must necessarily involve personal interactions with individuals at the policy-making level within the potential user organizations.

This does not mean that no other sources of information are available--quite the contrary. Newspaper articles of speeches given by members of the government agencies in question, engineering society proceedings, government reports summarizing governmental research activities, and records of congressional committee hearings are all sources of information for the data base, as are personal contacts between personnel in NASA and the potential user agencies at the technical working level. However, SRI personnel, working out of the Washington Office, have found that the currency and completeness of this information cannot be guaranteed without the use of personal contact at the policy-making level.*

b. Potential Use Development Activity

Implementation of the data-gathering activity outlined above permits NASA to identify potential uses of the STS that are relevant to potential government users. Following this identification, contact with the potential

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* Several people at SRI-Washington and within the government agencies contacted were asked if a list of documents could be compiled that would yield the desired information. The answer was a resounding "No". One reason specifically given for this answer was the observation that by the time the definition of a need gets into print, a solution is already in sight.

users should be made in order to develop interest in implementing these uses. The desired nature of this contact was at least partially determined in the nine meetings conducted by SRI personnel in and around Washington for this study. The primary findings of these meetings relevant to developing potential user interest are given below.

1) Image

Without exception, the offices contacted expressed the opinion that any interaction between NASA and a government user must be conducted in an atmosphere in which NASA approaches the potential user in a supporting role. That is to say, that in the interaction between NASA and the potential user NASA should demonstrate a knowledge of the potential user's goals and priorities and the specific needs for accomplishing these goals. NASA should be able to positively state its capabilities which can help the user satisfy those needs for attaining their goals. Such an approach permits NASA to be identified as a partner in the attack on the problems facing the potential user, and leaves the direction and responsibility for the overall problem solving program with the potential user. Such an approach requires, however, that the NASA representative be able to converse with the representative of the user agency in terms that both understand and that he be well informed as to what the goals, needs, and priorities of the user are. This approach will even permit development of uses in the Development of Transportation where some ill will exists from past interactions made in a manner contrary to that recommended.

2) Points of Contact

After a decision has been made within a potential user organization to pursue a specific program using NASA capabilities, it is appropriate for the technical personnel of both NASA and the potential user to work together to bring the potential use into operation. Such contacts have been made and used for years. They should be continued.

There is, however, a higher-level contact which is also needed. Inasmuch as any decision to implement the STS for a specific user involves questions of that organization's budget, manpower allocation, and perhaps even organizational structure, NASA must have some interface at the

policy-making level within the user organization. Such interaction has several advantages. First, a positive decision at this level to pursue development of a potential use yields a high probability of eventual implementation. Second, it reduces the time for a decision, either positive or negative, on implementing any single potential use. Third, continuation of such an interface: 1) affords a single point of contact through which major program problems may be resolved rapidly; 2) assures longevity of the NASA/user interface*; and 3) satisfies the requirements of NASA in the data-gathering activity described above.

However, in order to take advantage of the benefits of this high-level interaction activity, the NASA representative must be assigned to these responsibilities for the long term to preserve continuity. The NASA representative must also be able to gain access to the office of the appropriate policy planners within the potential user's organization. Also, since the appropriate point of contact may be as high as an Assistant Secretary (as in the Department of Transportation and, perhaps, the Department of Agriculture), at least some of these liaison personnel should report directly to the Office of the Administrator at NASA. Any lower position in NASA's organizational structure reduces the possibility of conducting substantive discussions with members of an Assistant Secretary's office on a regular basis. This peer status would be valuable in contacts outside the office, also. Additionally, to take full advantage of the high-level interaction postulated, the high-level NASA personnel must be recognized within NASA as the primary point of contact with the user, just as it is desired for the policy planner in the user organization to recognize him as such. In order to create this credible image, high-level liaison personnel should have available the following support:

(1) He should be able to get support from the NASA technical staff, as needed, to answer questions posed by the policy-planner of the user organization.

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* Thereby enhancing NASA's image as a long-term partner in the solution of problems other than its own.

(2) A procedure should be formally initiated which supports technical follow-ups on promising leads uncovered in his contacts.

(3) He should have the power to ask for a project review if it appears that the project is in trouble.

(4) He should be informed of the progress on each current project which supports the specific user with whom he is the primary point of contact.

Several more supporting functions could be identified which are needed if these high-level liaison personnel are to effectively fill their role as primary points of contact with potential users. This support is necessary to allow the liaison men to function in a manner similar to that of a project leader in a contract research organization. It does without saying that the responsibilities assigned to these men, although not completely outlined here, justify the level of support called for above. The Senate Committee on Aeronautical and Space Sciences feels that the type of individual for this job may not now be within the NASA organization.

3) Content of Contacts

The interaction between NASA's technical personnel and those of the user should have no restraints; they should be free to discuss not only the existence of, but the need for, further NASA support of the user. However, it is recommended that any such discussions on the need for further NASA support be reported to the high-level liaison representative, so that a single, primary point of contact can be maintained.

As indicated by the above discussion of the nature of the high-level interaction, it is not necessary that the high-level interaction include very much technical content: first, because it may well be that the high-level policy planner of the user organization is not a technical man, and secondly, even if he is, the potential user is not interested in a discussion of the technology but an identification of what NASA capabilities can do to solve his problems.

Just as assigning a single point of contact within NASA for each governmental user affords advantages in efficiency and reflects the desires of the potential users, it was found that the interactions with potential

users should take not only the capabilities of the STS into account, but the capabilities of NASA as a whole. This is not only efficient; it is the preference of the potential users contacted by SRI in this study.

4) Cost Estimates

Without exception, the potential agencies contacted said that one of the most important considerations that would have to be included in any decisionmaking process concerning the use of NASA capabilities was cost. In this regard, a comparison of costs (both initial procurement and operating costs) was deemed necessary very early in the decisionmaking process when more than one possible solution to a problem existed. Such a cost comparison may involve consideration of alternate solutions based on different NASA capabilities. Thus, it is recommended that all of NASA capabilities be treated in the high level interaction with the user organization. When unique opportunities are afforded by NASA capabilities for meeting the goals of a user organization, the cost benefits should also be stressed, though they may be highly subjective. Even in this latter case, the potential users contacted by SRI in this study indicated that costs and benefits will be considered very early in the decisionmaking process.

Under the circumstances outlined in the previous paragraph, it is imperative that NASA be able to give rapid and credible cost estimates for each potential use of the STS (or, for that fact, any other NASA capability) discussed with potential users.

c. Miscellaneous Findings

In addition to the conclusions given above, which are considered major in the sense that they directly affect the structure of the methodology developed in this SRI study, the meetings held between SRI and the nine agencies listed also lead to the following observations.

First, Research and Development (R&D) funds of the potential user agencies are limited; the majority of the funds at the disposal of these agencies is for operations. Thus, the largest potential for the use of NASA's capabilities lies in the operational phase of activities of a user. In addition, the term Research and Development has different meanings for

NASA and some of the potential users. There is very little work supported by potential users that NASA would call research; what these users call research is more nearly what NASA calls development, and the high-level liaison personnel must learn to make this distinction.

Secondly, the users already have a general knowledge and appreciation of NASA capabilities. However, the potential users also have some ideas as to what NASA capabilities can't do for them. For example, several potential users have pointed out that the resolution afforded by the Earth Resource Technology Satellite (ERTS) imagery is insufficient to meet their needs. There is, however, an intense users' interest in talking to NASA representatives to see if their needs can be met by a similar program using the STS or some other NASA capability.

Third, the potential users are ready now to talk with NASA concerning what NASA can do for them in their attempts to meet their goals as long as this interaction is tailored along lines to reflect the characteristics outlined previously in this section.

Lastly, the industry associations (such as the American Gas Association and the Petroleum Institute) will probably serve as a good source of information on potential uses on which these organizations would be happy to work with NASA in developing governmental interest for their implementation.